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CHARBON VACCINATION.

We were recently present, says a writer in *La Nature*, at the curious operation of vaccinating sheep according to the method proposed by M. Pasteur; and it has appeared to us that a description of the process would not prove uninteresting. The principle of this species of vaccination is based on the following facts:

The bacterium, which causes the death of an animal by *charbon*, is possessed of such virulence that a drop of blood from an infected individual, if introduced under the skin of a perfectly healthy one, will bring about its death in two or three days. But Messrs. Pasteur, Chamberland, and Roux have succeeded in attenuating the virulence of this particular bacterium and obtaining new species, whose virulence goes on decreasing.

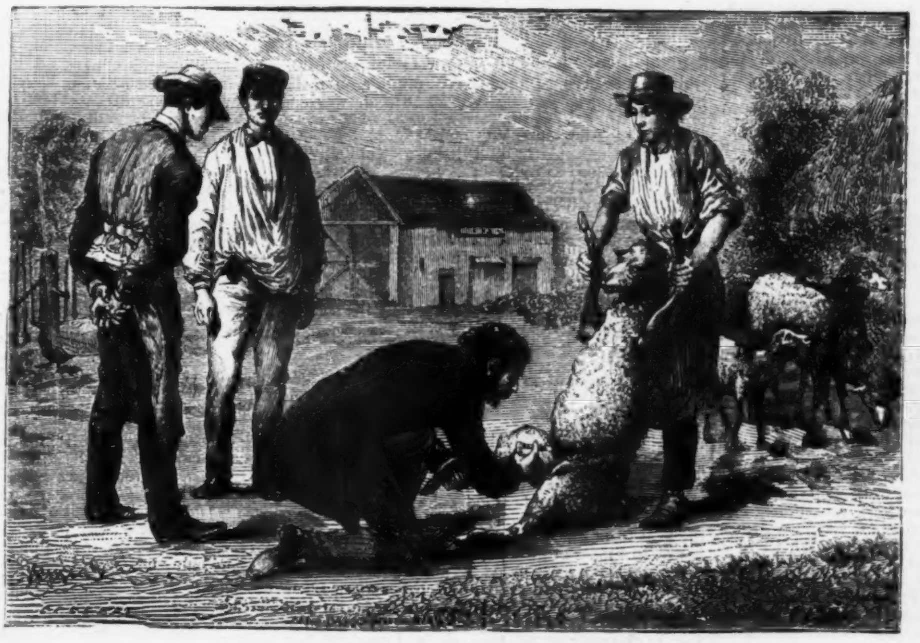
When an animal has had a mild form of the disease, through the introduction under its skin of bacteria of attenuated virulence, it is no longer apt to contract the mortal form, or, in other words, it is preserved from death through *charbon* for a certain length of time, whose duration has not as yet been determined.

There are two successive inoculations performed in the animal to be protected: the first, with a highly attenuated bacterium, having for a result the production in the animal of a very slight fever; and the second, with a more virulent bacterium, which would be liable to kill an animal that had not been submitted to the first inoculation. This second inoculation exhibits itself likewise by a slight fever; but the animal, then being definitely vaccinated, is proof against the charbon disease. Not only may sheep be vaccinated, but other domestic animals also, such as horses, cows, and goats.

The vaccine liquid is sent to its destination in corked glass tubes. For introducing it under the skin there is employed a Prabaz hypodermic syringe, such as used by physicians and veterinary surgeons. The instrument having been entirely filled with the liquid, an assistant seizes the animal to be vaccinated and presents it to the operator, as shown in the accompanying cut. The needle-point of the syringe is then introduced beneath the skin, and the liquid injected by pushing down the piston till division No. 1 is reached. This finishes one inoculation, and the operator then proceeds to the others, the contents of one syringe being sufficient to vaccinate eight animals. A skillful operator can inoculate thus more than a hundred and fifty sheep an hour. Fifteen days afterward the same operation is performed with the second vaccine matter—this time the left thigh being punctured.

When oxen, cows, or horses are operated upon, double the quantity of vaccine matter is employed; and, instead of its being introduced into the thigh, it is injected behind the shoulder in the case of cows, and into the neck and shoulders in the case of horses.

It is of the utmost importance that the vaccine liquid be of absolute purity, for if it were contaminated by unboiled water, dust, etc., there might be introduced into the blood foreign organisms which would prevent vaccination, and which might even be the cause of other diseases, such as septicemia, phlegmon, etc. The syringe should be new; and, after it has been once used, it should be thoroughly cleansed before employing it again. The vaccine matter should be preserved in a cool place—in a cellar, for example.



MODE OF VACCINATING SHEEP.

MALLEABLE BRONZE.

Dronier claims to have discovered a simple method of rendering bronze as malleable as copper, iron, etc. This consists in the addition of a very little mercury—one and a half and two per cent. It seems to act mechanically rather than chemically.

The mercury may be combined with one of the metals of which the bronze is made, before they are combined, by pouring it into the melted metal and stirring well, or it may be put into the melted copper along with the tin, or just after the latter has been added or an amalgam of tin is stirred into the melted copper.

EGYPTIAN LUSTRAL WATER VESSELS.

At the Centennial Exhibition there was exhibited an American money-box which distributed to visitors photographs of distinguished persons, provided that there was deposited in the apparatus a certain number of five-cent pieces. This was a renewal of an invention of the Egyptian priests, who, two thousand years ago, sold holy water to the faithful by an analogous process. This is the way in which Heron of Alexandria describes the sacerdotal money-box in his Treatise on Pneumatics:

"There are vessels such that, if a five-drachm* piece be thrown into them, there will flow from them water for ablutions."

"Let there be a lustral water-vase, $A B \Gamma \Delta$, whose orifice, A, opens at the upper part. In this vase there is a vessel, $Z H \Theta K$, containing water, and a small cylinder, Δ, closed at the bottom, from whence starts a tube, ΔM, which debouches outside. Near this vessel there is placed a vertical rod, $N \Xi$, around the upper end of which moves a horizontal lever, $O \Pi$, terminating at O in a flat dish, R, parallel with the bottom of the base. At the other end, Π, there is suspended a cover, Σ, which is so adjusted to the cylinder, Δ, as to prevent the water from flowing through the tube, ΔM. This cover must be heavier than the pan, R, but lighter than the pan and piece of money.

Fig. 1.—EGYPTIAN LUSTRAL WATER VASE.

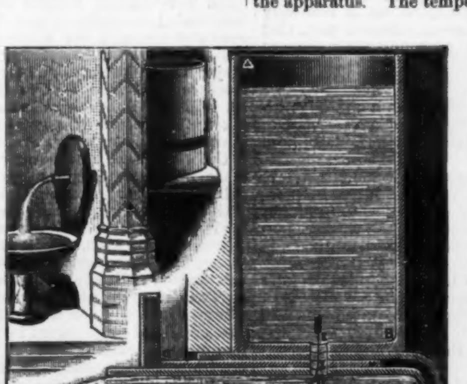


Fig. 2.—EGYPTIAN LUSTRAL WATER VESSEL.

"When a coin is dropped through the orifice, A, it falls on the pan, and its weight causes the tilting of the lever, $O \Pi$, thus raising the cover and permitting the water to flow. But the coin afterward falling to the bottom, the cover closes up the cylinder again and stops the flow."

There were also other holy-water vessels operated by a hand-wheel. Here is what the Alexandrian Engineer says about them:

"There are placed in Egyptian sanctuaries, near the portico, movable bronze wheels which those who are entering cause to revolve, because brass passes for purifying. It is expedient to arrange them in such a way that the rotation of the wheel shall cause the flow of the lustral water, of which we have just spoken."

"Let $A B \Gamma \Delta$ be a water-vessel hidden behind the posts of the entrance-doors (Fig. 2). This vessel is pierced at the bottom with a hole, E, and under it there is fixed a tube, $Z H \Theta K$, having an aperture opposite the one in the bottom of the vessel. In this tube there is placed another one, ΔM, which is fixed to the former at Δ. This tube, ΔM, likewise contains an aperture, Π, in a line with the two preceding. Between these two tubes there is adapted a third, $N \Xi O R$, movable by friction on each of them, and having an aperture, Σ, opposite E.

"If these three holes be in a straight line, the water, when poured into the vessel, $A B \Gamma \Delta$, will flow out through the tube, ΔM; but if the tube, $N \Xi O R$, be turned in such a way as to displace the aperture, Σ, the flow will cease. It is only necessary then to so fix the wheel, $N \Xi O R$, that, when made to revolve, the water shall flow."

This ingenious system of cocks, having several ways, was reproduced in the sixteenth century by Jacques Besson, in his *Theatrum instrumentorum et machinarum*. Besson applied it to a cask provided with compartments, which gave at will different liquors through the same orifice. Some years later, Denis Papin proposed it for high-pressure steam engines. Further improved, it has become the modern long D valve.

* About seventy-five cents.

SOLAR APPARATUS.

It will be remembered that M. Mouchot, a short time ago, devised an apparatus for utilization of solar heat, and that M. Pifre made some important improvements on it. Very different views have been taken as to the practical utility of such an apparatus. Some help toward a right judgment now comes from Montpellier, where a French Government Commission has been experimenting with the apparatus for a year (1881). Another commission has experimented at Constantine, in Algeria, but the results are not yet published. The apparatus was of the known form—a concave mirror, with blackened boiler in the axis, surrounded by a glass envelope. The steam from the boiling water was condensed in a coiled tube cooled by water. The weight of water distilled in an hour indicated the amount of heat utilized; and observations with an actinometer from hour to hour showed the amount of incident heat. The rates of these two quantities was a measure of the economic efficiency of the apparatus. The temperature and moisture of the air, etc., were also carefully noted. The number of days of observation was 177, and of observations 930, and water was distilled to the amount of 2,725 liters. Without entering much into numerical detail, we may state that while the heat utilized in the most favorable circumstances per square meter per hour would be about equal to that utilized from 240 grammes of coal (supposing about a half to be utilized)—even the half of this is not attainable in our climate. The sun does not shine continuously enough for practical utilization of the apparatus. In very dry and hot climates, the possibility of utilization would depend on various circumstances, such as the degree of difficulty of procuring fuel, the price and facility of transport of solar apparatus, etc. We note in the report (by M. Crova) that the efficiency of the apparatus is not proportional to the heat intensity of the solar radiations, and hardly ever varies in the same sense. The absolute quantity of heat utilized on the other hand, depends essentially on the temperature of the air: the higher this is, and the less consequently the cooling the greater the amount of heat utilized.—*London Times.*

The Acorn and the Helianthus Root in the Manufacture of Alcohol.—Both common acorns freed from their shells and the tubers of *Helianthus tuberosus* are capable of being used as a raw material in distilleries.—*Dr. H. Dill*

PITTSBURG AND HER MANUFACTURES.

The Chamber of Commerce of Pittsburg, Pa., has lately issued a very handsome pamphlet of 150 pages, containing sketches of the leading manufactures carried on in that industrious city. A fine panoramic view of the city is also given, of which we give opposite a reduced copy. The president of the board of directors of the Chamber of Commerce is Mr. J. K. Moorhead; superintendent, G. Follansbee, to whom we are indebted for a copy of the pamphlet; from it we abstract the following:

THE CITY OF PITTSBURG.

Population 235,000.

Two of the greatest names of the last century—Pitt and Washington—are indissolubly connected with our city. That of Washington, in the singular fact that he is the founder of Pittsburg—that on the 23d of November, 1753, he selected this point to plant a civilized community. This act, the very first in his long public career, inaugurated or precipitated war between the powers then claiming this continent, in which William Pitt received his most conspicuous monument by the bestowal of his name on the infant settlement. The struggle, it should be added, was also the moving cause that the first suggestion toward the formation of an American Union was made. Such momentous factors crowd around the infancy of our city. In the course of time, hardly less striking incidents might be mentioned, as, for instance, the siege of Fort Pitt, and the battle fought by Col. Bouquet, a victory signalized as the only one over the Red man for over a third of a century.

Our sturdy settlers in 1776 preceded by several months in their declarations, adopted within a few miles of Pittsburg, that which has made the Fourth of July a national holiday for all time to come. This glorious record was, fifteen years later, somewhat tarnished by Western Pennsylvania rising in insurrection against the newly formed Federal Government on account of the imposition of the tax on distilled liquors. Yet, in extenuation of the rash action of the people, it was recognized that the only way of bringing cereal products to market, in the absence of all roads and highways was by converting them into whisky. This consideration had another striking consequence, in that it led a very distinguished man, Robert Fulton, to devote his thoughts to the invention of steam navigation. And in due course it came to pass that one of the very first steamboats built here was instrumental in bringing the sorely needed supplies of all kinds to Gen. Jackson at New Orleans. In the making of them, the whole town of Pittsburg—men, women, and children—joined, and without these it would have been impossible for the American army to resist the invaders. Commodore Perry derived, in like manner, his most essential naval furnishments from Pittsburg, supplied with which he was enabled to fight his glorious battle of Lake Erie. Since that time, no less than 4,000 cannon have been cast at Pittsburg for the National Government. In every war fought, Pittsburg has been called upon to furnish enginery and material of all kinds—and Divine Providence has often permitted the most essential services to be rendered by hands supplied with weapons made here.

But it is entirely more consonant to the feelings of our people to point to their achievements in the fields of peaceful industries—to all those things we have contributed and are contributing to make this nation great and prosperous. There is not a house in all the vast West in which there is not some article of Pittsburg manufacture. The whole world, civilized and semi-civilized, burns petroleum, first established as an industry by Pittsburg. The copper regions of Lake Superior were first developed by men of enterprise and means from this section. Novel principles in steam transport service by water were first applied by our river men, enabling them not only to build boats of lighter draught than those of any other locality, but also handling a greater tonnage by any single craft on a narrow and crooked river, than has ever been done, with the sole exception of the Great Eastern. These two factors have become of continental importance as regards the magnificent system of water-ways stretching from this city to the Gulf, and westwardly to within 800 miles of the Pacific. Twenty thousand miles of inland navigation are thus tributary to our merchants and manufacturers.

We have no disposition to undervalue the importance of railroads to modern life. A locality which finishes a locomotive every second day, and makes a steel rail every minute throughout the year, could not be blind to these elementary facts. Our railway system centers arteries of the three great trunk lines of the country. The extent of the tonnage is only imperfectly given by the statistics, but is concisely expressed in the phrase current among railroad men, that "Pittsburg originates more freight than any other place in the country."

COAL.

The wonderful prosperity of Pittsburg as a manufacturing center is chiefly due to its possession of a vast vein of bituminous coal, unexcelled in quality for gas, steam, and domestic purposes.

The area of the coal fields of the world is 260,000 square miles, of which the United States contains 192,000 square miles, or 74 per cent. of the total area. The bituminous coal field of Pennsylvania, which underlies the western portion of the State, and by which Pittsburg is surrounded, is estimated to contain 14,000 square miles. It is not, however, from the mere matter of area in square miles that the value of a coal deposit is to be estimated, nor the success of a coal trade builded upon. The essential requirements are:

1st. Quality of the coal.

2d. Thickness and regularity of the vein, and its accessibility.

3d. Cheapness and sufficiency of transportation to market.

The Pittsburg vein eminently combines these requirements. Concerning its quality, H. D. Rogers, in his report of 1839, says: "The seam is from 5½ to 8 feet high, affording coal of the purest and best kind." And Andrew Roy, in "The Coal Mines," says: "This coal is of the best bituminous quality in the United States for the generation of steam, the manufacture of gas and for household use." And again: "This seam of coal has become celebrated by reason alike of its excellence as a mineral fuel and its great extent of area. It is beyond all question the richest bituminous coal in the United States; even in its most inferior character it is still a first class coal." Of the accessibility of the vein, Sir Charles Lyell, the eminent English geologist, says: "I was truly astonished now that I had entered the hydrographical basin of the Ohio, at beholding the richness of the seams of coal which appeared everywhere on the flanks of the hills and at the bottoms of the valleys—and which are accessible in a degree I never witnessed elsewhere. The time has not yet arrived when the full value of this inexhaustible supply of cheap fuel can be appreciated."

When it is remembered that in some of the deepest mines of England, France, and Belgium, an expenditure of from $300,000 to $500,000 is not unfrequently made before the first ton of coal is raised, and that seams of coal are mined whose thickness does not exceed from 1¼ to 2 feet, the great advantages in the mining of this vein, outcropping on the flanks of the hills and the banks of the rivers, requiring not one dollar of investment to reach the coal (the investment necessary to the business being that only for transportation facilities from vein to carrier, or market), may be appreciated. The character of the coal, too, is of such consistency as to stand the necessary handling for its being marketed without having its value appreciably impaired by crushing, and yet permits its mining with the use of but little, if any, explosives. Concerning the requirement of cheapness and sufficiency of transportation of this coal to the markets, the conditions by both river and rail are such that the term "unparalleled" is used to describe them by writers on this subject. That part of the product which is used for manufacturing and domestic purposes in Pittsburg is largely delivered by rail, and is hauled distances varying from 8 to 20 miles, upon which the freight is from 20 to 40 cents per ton of 2 000 pounds, while that shipped by the Monongahela slack water to Pittsburg is largely reshipped by the Ohio and Mississippi rivers to points between Pittsburg and New Orleans. It is stated that coal is shipped by this great water route a distance of about 2,000 miles for 95 cents per ton, which also includes the return to mines of the empty craft. Consider it—2,000 miles—one ton—95 cents! "Unparalleled" is not inaptly used.

The coal production of the world, for 1872, as per compilation of James Macfarlane, was, in round numbers, 220 000,000 tons, of which Great Britain produced the largest quantity, or 51 per cent. of the whole, and the United States the next largest quantity, or 19 per cent. of the whole. The census report of coal production of the United States for the year ending June 30, 1880, shows the quantity produced to have been 42,417,764 tons, of which the three counties of Allegheny, Westmoreland, and Fayette, which are largely dominated by Pittsburg's capital, energy, and brains, produced as follows:

Allegheny, 4,426 871; Westmoreland, 3,297,300; Fayette, 2,318,728—a total of 10,042,899 tons, or nearly 25 per cent. of the entire quantity, Allegheny county alone furnishing more than 10 per cent. of the whole. Granting, then, that the coal output of the globe from 1872 to 1880 increased in the same ratio as that of the United States, and the summing up is: Pittsburg, in 1880, furnished nearly 25 per cent. of the bituminous coal output by the second largest coal producing country of the world.

THE COKE INDUSTRY.

Within a few miles from Pittsburg are 8,000 coke making "ovens" of the industry. From these constantly arise clouds of smoke, and volumes of gas and noxious fumes. The ovens are of simplest form and construction, merely a "bee hive" of fire brick, with an aperture at the apex and a small doorway at one side of the base. In the former is dropped the coal as it comes from the pit, and from the latter is "drawn" the finished coke. A "charge" of coal fills one-third or one-half the interior space of the oven, and the heat from the previous charge converts this coal, in 48 hours, to a mass of glowing coke. The access of air during the combustion is retarded by almost closing the doorway during the coking process. The mass, after being cooled by water, is drawn out in large irregularly shaped fragments, and placed in cars for shipment. A coke oven is twelve feet in diameter at the base, six and one-half feet high at the center, and is constructed of fire brick. The number of ovens given above will, in the present year, be increased to about 10,000. The price of this fuel is at present $1.75 per ton on board cars at the ovens, a price which in some cases is enhanced twenty-fold by freight charges before the article reaches the most distant consumers.

Capital invested, $10,854,500; hands employed, 5,659; value of product, $4,423,559; amount of product, 138,001,840 bushels, or 2,760, 037 tons.

BLAST FURNACES.

William Turnbull and Peter Marmie, of Philadelphia, built a furnace and forge on Jacob's Creek, a mile or two above its entrance into the Youghiogheny River. The furnace was first blown in on November 1, 1790, and the iron was tried the same day in the forge. The furnace and forge were on the Fayette county side of the creek, and were called the Alliance Iron Works. The furnace was successfully operated for many years, and the stack is still standing, but in ruins. An extract from a letter written by Major Craig, deputy quartermaster general and military storekeeper at Fort Pitt, to General Knox, dated January 12, 1792, says: "As there is no six-pound shot here, I have taken the liberty to engage four hundred at Turnbull & Marmie's furnace, which is now in blast."

Union furnace, now Dunbar furnace, was built by Colonel Isaac Meason, on Dunbar Creek, four miles south of Connellsville, in 1791, and put in blast in March, 1791.

George Anshutz, the pioneer in the manufacture of iron at Pittsburg, was an Alsatian by birth. He was born November 28, 1753. In 1789 he emigrated to the United States, and soon afterward located at a suburb of Pittsburg, now known as Shady Side, where he built a small furnace on Two Mile run, probably completing it in 1792. In 1794 it was abandoned for want of ore. It had been expected that ore could be obtained in the vicinity, but the expectation was not realized, and the expense entailed in bringing ore from other localities was too great. In 1794 the fire of the furnace lighted up the camp of the participants in the whisky insurrection. The enterprise seems to have been largely devoted to the casting of stoves and grates. The ruins of the furnace were visible until about 1850. Anshutz died at Pittsburg, February 28, 1837, aged eighty-three years.

Less than 50 years ago the American blast furnace, which would make four tons of pig iron in a day, or 28 tons in a week, was doing good work. We had virtually made no progress in our blast furnace practice since colonial days. In 1831 it was publicly proclaimed with some exultation that "one furnace erected in Pennsylvania, in 1830, will in 1831 make 1,100 tons of pig iron."

On March 23, 1880, the A furnace of the Edgar Thomson Steel Works, near Pittsburg, 65 feet by 13 feet, made 113 gross tons of pig iron, with a consumption of 1,965 pounds of coke per ton of pig iron, and on ores yielding 4·02 per cent. The B furnace, 80 feet by 20 feet, made 208 tons of pig iron on November 22, 1880. The C furnace, 80 feet by 20 feet, made 224 tons of pig iron on April 28, 1881, the fuel consumption being at the rate of a ton of coke to the ton of pig iron. The best week's work of the C furnace was 1.357 tons, and the best month's work was 5,598 tons.

In the week ending March 28, 1879, the Lucy furnace No. 1, 75 feet by 20 feet, at Pittsburg, made 857 gross tons of pig iron; in the seven days ending March 31, it made 945 tons; in the month of March it made 3,684 tons, a daily average of 118 tons. On November 21, 1880, it made 202 tons in 24 hours.

The Isabella furnace No. 1, at Etna, Allegheny county, 75 feet by 18 feet, made 702 gross tons of pig iron in one week in 1875. The Isabella furnace No. 2, 75 feet by 20 feet, made 770 tons in one week, in November, 1875; its best day's work in the same week was 116 tons. In one calendar month in 1875 it made 3,163 tons. No. 1 has recently been widened to 20 feet, and has made 1,130 tons in one week in 1881.

One of Shoenberger, Blair & Co.'s furnaces, at Pittsburg, 65 feet by 13½ feet, made 423 gross tons of pig iron in one week, in December, 1876.

One of Laughlin & Co.'s furnaces, at Pittsburg, 61 feet by 16 feet, made in one day, in 1880, 130 gross tons of pig iron; in two consecutive days it made 253 tons.

Dunbar furnace, No. 1, at Dunbar, Fayette county, Pennsylvania, 77 feet by 20 feet, made in a thirty-day month, in 1880, 2,182 gross tons of pig iron on 83 bushels of coke to the ton; the ores yielded for that month 42·5 per cent. of metallic iron. The best week's work during the month was 520 tons, and the best day's work was 80 tons. The best three day's work during this entire blast was 83, 85, and 87 tons respectively.

The growth of the iron and steel industries of the United States during the present century is, perhaps, best exemplified in the statistics of the production of our blast furnaces at various periods. In 1810 we produced 53,908 gross tons of pig iron and cast iron; in 1840 we produced 315,000 gross tons; in 1860 we produced 821,223 gross tons, and in 1880 we produced 3,835,191 gross tons. Our production in 1881 will be about 4,500,000 gross tons.

The world's production of pig iron was in 1880, 17,688,596 gross tons, and the world's production of steel in the same year, 4,343,719 gross tons. The percentage of pig iron produced by the United States was nearly 22, and its percentage of steel was nearly 29.

Blast furnaces — sixteen stacks; ten establishments. Capital invested, $4,890,000; hands employed, 2,285; value of product during the year, $8,766,493; amount of product, 353,791 tons pig iron (including 8,630 tons spiegeleisen).

ROLLING MILLS.

Mr. J. M. Swank, in his report for the United States Census, states that in 1817, at Plumsock, in Fayette county, Pennsylvania, the first rolling mill in the United States for the production of bar iron was erected.

It was not until 1844 that Pittsburg commenced to roll any other kind of rails than strap rails for our railroads, and not even in that year were we prepared to roll a single ton of T rails. In 1880 we rolled 1,305,212 gross tons of rails, nearly two-thirds of which were steel rails, and nearly all of which were T rails.

The first rolling mill at Pittsburg was built in 1811 and 1812, by Christopher Cowan, an Englishman. It was called the Pittsburg rolling mill. This mill had no puddling furnaces, nor was it built to roll bar iron. It was built to manufacture sheet iron, nail and spike rods, shovels, spades, etc.

Among the remarkable achievements noted by Mr. Swank as having been accomplished by Pittsburg workmen, is mentioned that of rolling some thin sheet iron of which it took 15,500 leaves to make an inch in thickness.

Capital invested, $19,020,000; hands employed, 18,905; value of product during the year, $30,242,257.

KINDS OF GOODS MANUFACTURED.

Merchant bar, hoop, band, boiler plate, tank and sheet iron, wrought iron pipe and boiler tubes, railroad spikes, nails and tacks, horse shoes, galvanized sheet iron and light plates, skelp iron, axles, etc., etc. Railroad specialties, bridge rods, angles, and peculiar shapes.

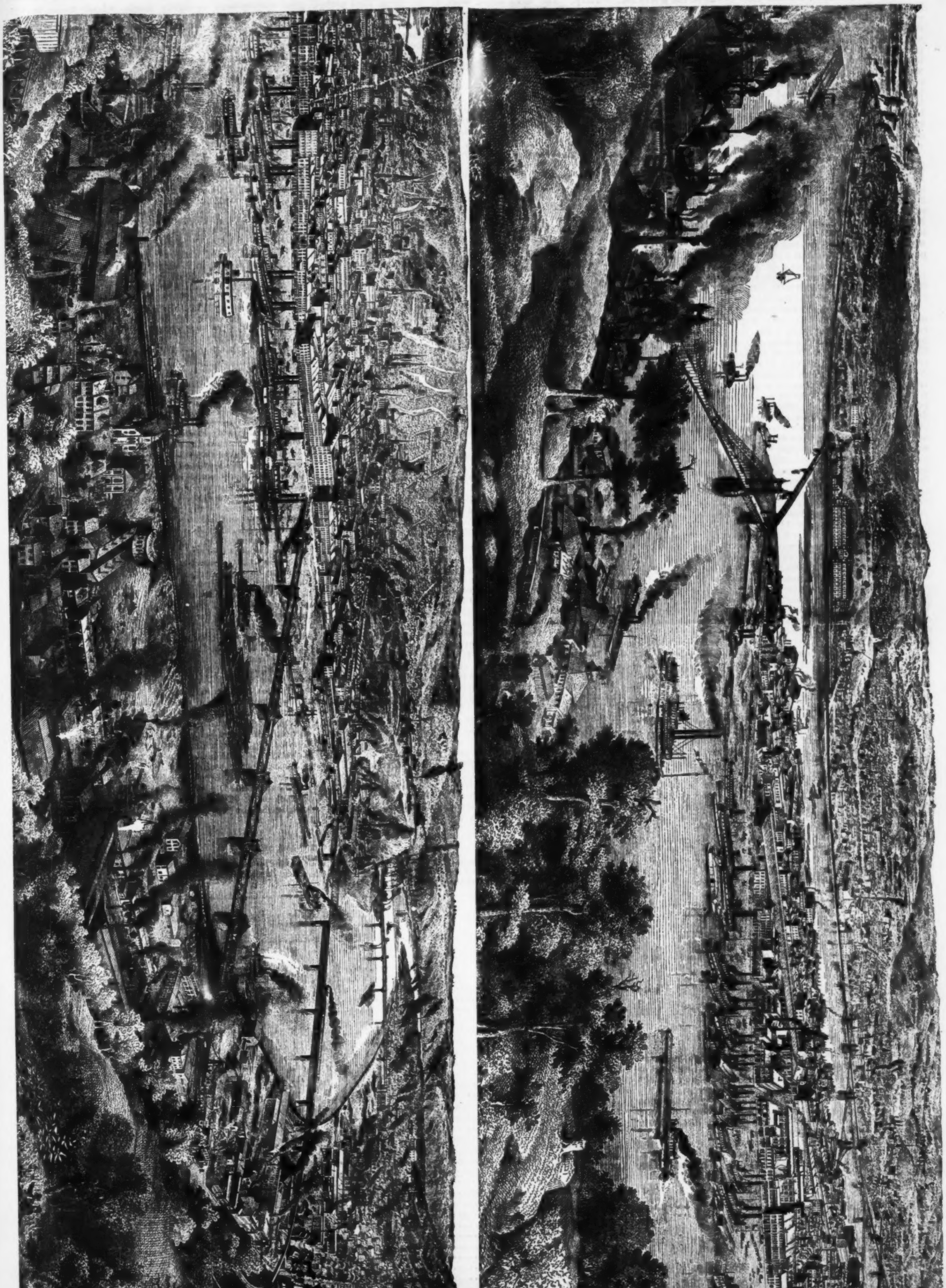
Total amount of product, 475,148 tons.

Two of the above establishments—namely, Dilworth, Porter & Co., Limited, and Jones & Laughlins, manufacture railroad and other spikes. Four establishments—namely, Shoenberger & Co., Jones & Laughlins, Moorhead & Co., Zug & Co., manufacture nails. Chess, Cook & Co. manufacture nails and tacks. There are two other rolling mills with nail machines which did not manufacture last year. In all, 419 nail machines.

The total production for the year was, spikes—21,600 tons; nails—555,331 kegs of 100 pounds each; small nails and tacks—11,500 boxes.

STEEL.

Although this country cannot produce iron and steel as cheaply as European countries which possess the advantages of cheap labor and proximity of raw materials, it is not excelled by any other country in the skill which it displays or the mechanical and scientific economies which it practices in any branch of their manufacture, while in certain leading branches it has displayed superior skill and shown superior aptitude for economical improvements. Our blast furnace practice is the best in the world, and it is so chiefly because we use powerful blowing engines and the best hot-blast stoves, possess good fuel, and carefully select our ores. The excellent quality of our pig iron is universally conceded. Our Bessemer steel practice is also the best in the world. We produce much more Bessemer steel and roll more Bessemer steel rails in a given time by a given amount of machinery, technically termed a "plant," than any of our European rivals. No controversy concerning the relative wearing qualities of European and American steel rails now exists, and no controversy concerning the quality of American Bessemer steel ever has existed. We experience no difficulty in the manufacture of open-hearth steel in the Siemens Martin furnace, and our steel which is thus produced is rapidly coming into general use side by side with crucible steel. In the manufacture of crucible steel our achievements are in the highest degree creditable. In only one respect can it be said that in its manufacture we fall behind any other country; we have not paid that attention to the manufacture of fine cutlery steel which Great Britain has done. This is, however, owing to commercial and not to mechanical reasons. American crucible steel is now used without prejudice in the manufacture of all kinds of tools, and in the manufacture of carriage springs and many other articles for which the best kinds of steel are required. In the quantity of open-hearth and crucible steel produced in a given time by a given plant, we are certainly abreast of



PANORAMIC VIEW OF PITTSBURG AND ALLEGHENY, PA.

all rivals. The largest crucible steel works in the world are located at Pittsburg.

In 1810, seventy years ago, we produced only 917 tons of steel, none of which was crucible steel. In 1831, fifty years ago, we produced only about 2,000 tons of steel, not one pound of which was crucible steel of the best quality. So imperfect were our attainments as steel makers in 1831 that we considered it a cause of congratulation that "American competition had excluded the British common blister steel altogether." In 1880 we had virtually ceased to make even the best blister steel, better steel having taken its place, and in that year we produced 1,247,335 gross tons of steel of all kinds, 64,664 tons of which was crucible steel. Our production of Bessemer steel and Bessemer steel rails in 1880 was larger than that of Great Britain.

Of the production of 76,2 1 tons of crucible steel ingots in 1880, Pennsylvania made 60,303 tons, or 79 per cent.; New Jersey, 10,492 tons, or 14 per cent.; New York, 2,585 tons, or over 3 per cent.; Connecticut, 2,116 tons, or under 3 per cent.; and Ohio, Massachusetts, Illinois, and Kentucky, an aggregate of less than 1 per cent. Pennsylvania, New Jersey, and Connecticut, also unitedly produced 4,956 tons of blister steel and miscellaneous steel products, of which Pennsylvania produced 78 per cent., New Jersey 20 per cent., and Connecticut 2 per cent.

In the twelve months ending January 31, 1881, two converters at Pittsburg made 130,694 gross tons of Bessemer steel ingots; the steel rail mill rolled 106,722 tons of steel rails; and the billet mill rolled 3,421 tons of billets.

Two converters made the following product in the ten months ending October 31, 1881: Ingots, 129,284 gross tons; rails, 112 835 tons; forgings, 1,226 tons. The largest runs made in these ten months were as follows: Best 24 hours, 654 tons of ingots and 578 tons of rails; best month, 14,461 tons of ingots and 13,246 tons of rails. In the week ending November 5, 1881, these works surpassed their previous record, making 3,580 tons of ingots and 3,112 tons of 56 pound rails, but they subsequently exceeded even this large product. In November, 1881, a 30-day month, they produced 16,193 tons of Bessemer steel ingots and 13,646 tons of rails. The best week's work was 3,902 tons of ingots and 3,202 tons of 56 pound rails. The best 24 hours' work was 700 tons of ingots and 608 tons of 56 pound rails.

On the 6th of September, 1881, Pittsburg put in operation for the first time a seventeen-ton steam hammer, which is the largest in the United States. It will work steel ingots two feet square. The anvil, which is the heaviest iron casting ever made in this country, weighing 160 tons, was cast a few feet from its place with five cupolas, on October 5, 1880; its dimensions are 11 feet high, 8 by 10 feet at the base, and tapering to 4 by 6 feet at the top. The hammer and its fittings occupy a ground space 26 feet long by 13 feet wide. Its height from the ground is 32 feet. The framing is of wrought iron plates, bolted and riveted and strengthened with angle irons. The weight of the cast iron cylinder is about 11 tons, the bore 40 inches, and the stroke 9 feet. The piston, rod, ram, and die weigh about 17 tons. When the steam is admitted on top of the piston it will produce an additional force or weight of about 50 tons, making 67 tons pressure in all when the ram or hammer is stationary.

In September, 1874, there was rolled here a crucible steel plate 180 inches long, 53 inches wide, and three-fourths of an inch thick, weighing 2,700 pounds.

In July, 1877, was rolled a band saw in one continuous piece, 54 feet long, 8 inches wide, and of No. 15 gauge.

We are to-day the second iron-making and steel-making country in the world. In a little while we shall surpass even Great Britain in the production of steel of all kinds, as we have already surpassed her in the production of Bessemer steel, and in the consumption of all iron and steel products. The year 1882 will probably witness this consummation.

The development of the steel manufacture in Allegheny county has been so rapid and extensive as to almost pass belief. Twenty years ago two crucible steel works were struggling for recognition in the markets of the country; to-day we have in Pittsburg and vicinity, seven large crucible steel plants, one of them probably the largest in the world. Also, two open-hearth steel plants and three Bessemer plants, one of these again being known the world over for its immense output. There is also one steel casting plant in successful operation, and another is being built.

Pittsburg steel, of fine grade, now competes successfully with all of the fine steels in the world. There is no kind of steel used, from the finest drill rod and needle wire, fine cutlery, lathe, axle, and all tool steel, to the heaviest plates and shafts, that are not made, and as well made as they are in any country; and Pittsburg manufacturers and mechanics have good reason to be proud of their splendid achievements in this industry.

Steel manufacturers—seventeen establishments.

Capital invested, $10,170,000; hands employed, 7,060; value of product during the year, $18,378,836; amount of product, 139,073 tons steel rails; steel in other forms, 72,344 tons. Total, 211,417 tons of steel.

KINDS OF GOODS MANUFACTURED.

Bessemer steel rails, blooms and billets, eye bars, plates, etc., for bridges; merchant and tool steel; steel castings to pattern; German and other steel, for buggies, wagon springs, and axles.

In the total products, as shown above, the Spang Steel and Iron Co., Limited, and the Pittsburg Bessemer Steel Co., Limited, are not included, both of those firms having only recently commenced operations.

File manufacturers—five establishments.

Capital invested, $20,000; hands employed, 40; value of product during the year, $30,000; amount of product, 8,000 dozen.

R. R. SUPPLIES.

Locomotives, cars, car wheels and springs, car shapes forged and fitted for use, rails, splice bars and nut locks, are made here in almost unlimited quantities. One little item of a rail fastening alone has consumed more than a thousand tons of steel in the last five years, each piece weighing just one ounce. One concern can turn out more than thirty tons of elliptic springs every day; and two others can turn out as much weight in coiled springs. Pittsburg locomotives, from the heaviest freight and express engines to the tiniest mine engines no higher than a pit mule, may be found all over the country, doing all sorts of work, and doing it well. There is no requirement of a railroad, in iron or steel, in the bar or finished to shape, that may not be had of the best quality in our Pittsburg shops. And in this connection we may include bridges, roofs, and trusses of all sorts. There are several large bridge works in Pittsburg, and they have done some of the best work in the country. The most noted work is the great steel arched bridge at St. Louis, and the longest girder span in the country, at Cincinnati; and others beyond our space to be even mentioned, prove the capacity of Pittsburg bridge builders. It is sufficient to say that no bridge built in Pittsburg has yet fallen down.

Railway supplies—locomotives, cars, springs, etc. Six establishments.

Capital invested, $1,435,000; hands employed, 1,102; value of product during the year, $3,177,817.

Total of product for the year, 154 locomotives, and large amount of supplies, locomotive tenders, etc.; 500 freight cars; 12,282 tons finished springs, railroad axles, steel forgings, etc.; 5,000 tons castings, in car wheels, etc.

Bridges, iron, etc.—three corporations or firms.

Capital invested, $570,000; hands employed, 752; value of product, $1,462,000. Product in tons, 12,950.

BOILERS AND TANKS.

Pittsburg being one vast workshop, and its steam engines and boilers constantly increasing in number, the demand for steam boilers called into existence extensive establishments. These not only supply the local demand for iron and steel boilers, but send their product to all parts of the country. Here, also, the demands of the fleet of river steamers is an important factor. Pittsburg-made steel boilers for steamboats are to be found on every navigable river west of the Allegheny Mountains, as well as the navigable waters of South America. The oil trade of Western Pennsylvania has greatly stimulated this trade, inasmuch as a large proportion of the great oil-storing tanks of the region are manufactured in Pittsburg. These tanks, holding from 20,000 to 40,000 barrels of oil each, form a unique feature in the scenery all along the Allegheny Valley. The aggregate tankage of the oil region and refining points amounts to over twenty millions of barrels.

SAWS AND TOOLS.

The pine forests, from Maine to Michigan and Oregon, are melting away before the Pittsburg circular saws, and the tougher oak and hickory and walnut of other States is shaped by the same implements. In far-off Brazil and Central America, Pittsburg saws shriek through tropical woods, and the stamp of the Pittsburg saw maker is as familiar to the lumberman of South America as to the shingle cutter of the upper Allegheny. Every grade and form of saw is turned out of the factories of Pittsburg, except, probably, the French band saw, and that this will follow in good time seems certain.

GLASS MANUFACTURES.

Pittsburg has for many years been the great glass manufacturing center of the country, owing to the fact that the facilities for making glass in this locality are unequaled. The manufacture of glass has been conducted in Pittsburg for a period of eighty-seven years. The original projectors of the industry were James O'Hara and Major Isaac Craig, who began the business of manufacturing window glass in 1795. In 1802 Gen. O'Hara constructed the first flint glass factory, and ever since the industry has been pursued profitably. To-day there are seventy-five glass factories in this region, twenty-four devoted to the manufacture of table ware, twenty-four engaged in the manufacture of window glass, eight in which flint glass bottles are made, ten exclusively engaged in the manufacture of green glass bottles and nine which produce lamp chimneys. These factories are owned by fifty-nine firms. The capital invested in them amounts to $5,985,000. They give employment to 6,442 operatives, and the value of the annual product in 1881 was $6,832,683.

Intimately connected with and dependent on these are the establishments devoted to the business of making glass moulds. Three of these give employment to forty hands, whose wages amount to $30,000 a year, and the value of whose annual product amounts to $70,000.

Two establishments are exclusively engaged in the business of making pots in which the glass is melted. They give employment to eighty hands, whose wages in 1881 amounted to $25,000. These establishments consume annually five hundred tons of German clay, and eleven hundred tons of Missouri clay.

The glass chimney factories may be cited as illustrating the enterprise of our people. The growth of these, which was very rapid, may be traced directly to the development of petroleum in Pennsylvania. They furnish employment to 830 hands, and the chief items of consumption will give some idea of the material required to operate them. They consume annually 350 tons of pearl ash, 500 tons of lead, 640 tons of soda ash, 320 tons of nitrate of soda, and 3,640 tons of sand. All the flint glass chimneys in the country, and very nearly 80 per cent. of all other kinds of glass chimneys are made in Pittsburg; the aggregate number made here exceeds forty millions annually.

The factories devoted to the manufacture of the finer and more elegant products (crystal glass) give employment to 1,850 hands, consume annually 3,300 tons of soda ash, 800 tons of nitrate of soda, and 13,000 tons of sand. The product of these factories is not surpassed in elegance of design or beauty in the United States. They are found in every city, town, and hamlet in the country.

The extent of the window glass trade of Pittsburg may be understood when it is stated that the product of one year required 720,000 packages, or boxes, each of which contained 50 feet of glass. A quarter of a million houses are glazed every year with Pittsburg glass.

The product of the bottle factories in a single year amounted to upwards of five hundred and ten thousand gross, or seventy-three million four hundred and forty thousand vials and bottles.

The plate glass factory which is in process of construction at Hite's station, on the West Penn railroad, seventeen miles from the city, is rapidly nearing completion. The shop will cover a surface of eight acres, and will be one of the largest establishments of the kind in the country.

SALT AND BROMINE.

The locality of Pittsburg is, geologically considered, favorable to the production of salt, and by deep boring, saline strata and deposits are reached and successfully worked. At a depth of nearly 2,000 feet salt water is reached from any point at or near the city, while within a short distance is found not only an inexhaustible supply of salt water, but an equally remarkable quantity of natural gas, which comes to the surface with the liquid and serves to aid in evaporating the brine. In addition, the adjacent salt regions of the Ohio Valley, at and surrounding Pomeroy, Ohio, contribute to Pittsburg's industries by the shipments of salt via river to the city, where the article is shipped by rail to eastern and other points. A short distance up the Allegheny River are found the numerous salt wells which line the shores of the above river, as well as of its tributary, the Kiskiminetas. These were opened subsequently to those of Syracuse, in Western New York, and Onondaga, in the same section of the Empire State. Previous to the war of 1812 Pittsburg, or in fact, Western Pennsylvania, was unknown as salt producing points. Then the wells sunk upon the Kiskiminetas and the Allegheny supplied thousands of consumers along the Ohio and Mississippi. Still later, the wells bored within the limits of the twin cities of Pittsburg and Allegheny tapped the hidden wealth. A well drilled from the top of a hill in the heart of the city yielded millions of gallons of strong brine which ran to waste. This well was bored for oil, and abandoned by reason of the strong flow of the less valuable fluid. An attendant industry is the production of bromine from the "mother liquor" yielded by the salt wells. This substance is extensively used in the manufacture of medicine, photography, and other technical arts. No less than 82,400 lb. of bromine are made here annually.

Capital invested, $139,000; hands employed, 90; value of product—salt, $142,435; bromine, $24,122; amount of product during the year—salt, 818,427 bushels; bromine, 82,400 lb.

ALPHABETICAL SUMMARY

Showing class of manufactures, number of establishments, amount of capital invested, number of hands employed in each branch of industry (exclusive of the retail industries), with the value of the manufactured products in the cities of Pittsburg and Allegheny and immediate vicinity.

CLASS OF MANUFACTURES.	No. of Establishments	Cash Capital Invested.	Number of Hands Employed.	Value of Product.
Agricultural Implements	5	$400,000	365	$675,000
Boots and Shoes	3	150,000	405	467,000
Boilers, Tanks, etc.	12	645,800	776	1,450,000
Brass Founders	16	683,000	330	1,300,000
Brewers	21	1,730,500	429	1,895,752
Bottlers	18	189,000	162	430,000
Britannia Ware	3	70,000	104	127,000
Brushes	3	65,000	65	142,000
Brooms	4	42,000	112	124,875
Bridges, Iron	3	570,000	752	1,462,000
Bakers, Crackers, etc	5	230,000	235	620,000
Boating, Rivers	..	7,447,000	3,260	2,400,000
Coal	67	15,552,000	17,962	12,208,306
Coke	60	10,854,500	5,659	4,423,559
Copper	2	600,000	120	975,000
Chemicals, Acids, etc	4	1,345,000	511	1,283,583
Cooperage	35	718,000	723	1,153,000
Cotton Mills	3	562,500	873	785,000
Clothing, Wholesale	5	500,000	565	1,021,000
Confectioners, Wholesale	13	581,000	175	1,154,000
Carriage Makers	31	333,000	300	400,000
Cigars	270	250,000	984	730,000
Cigar Boxes	3	3,000	20	30,000
Distillers	7	1,250,000	268	4,470,000
Domestic Hardware	5	391,000	416	500,000
Founders, Machinists, etc	35	2,740,000	2,083	3,953,000
Flouring Mills	3	340,000	70	1,158,930
Fire Brick and Tile	10	858,000	845	1,029,500
Furniture, Chairs, etc	57	491,500	475	1,220,000
Files	5	20,000	40	20,000
Glass	59	5,985,000	6,442	6,832,683
Gold and Silver Plating	5	30,000	32	57,000
Guns, Pistols, etc	5	100,000	59	257,000
Grocers' Supplies	6	175,000	270	525,000
Harness and Saddlery	43	250,000	170	450,000
Iron, Rolling Mills	36	19,020,000	18,905	30,242,257
Iron, Blast Furnaces	16	4,890,000	2,285	8,766,493
Iron Railings and Fences	6	100,000	85	204,000
Iron Roofs, Cornices, etc	3	167,000	141	816,000
Lubricating Oil	7	162,000	61	638,000

ALPHABETICAL SUMMARY—CONTINUED.

CLASS OF MANUFACTURES.	No. of Establishments	Cash Capital Invested.	Number of Hands Employed.	Value of Product.
Lard Oil	4	75,000	15	180,000
Lumber, etc.	86	1,072,000	1,450	3,748,000
Looking Glass Frames	3	75,000	40	150,000
Miscellaneous Lead and Iron	7	1,510,000	1,050	5,962,921
Miscellaneous Manufacturing Establishments	10	1,099,000	845	1,405,000
Nail Kegs	5	25,000	75	53,000
Newspapers	33	1,029,000	426	1,154,000
Paper Mills	5	950,000	535	1,345,000
Plumbers and Gas Fitters	80	204,000	297	507,200
Patent Medicines	5	262,681	197	649,050
Printing	61	250,000	460	560,000
Paper Boxes	6	37,000	80	90,000
Planing Mills	23	338,000	475	850,000
Pork Packers	7	750,000	150	1,0,0,000
Railway Supplies	6	1,435,000	1,102	3,177,817
Steel	17	10,170,000	7,060	18,378,836
Saws and Tools	6	910,000	834	1,345,850
Stoves	7	444,000	406	693,000
Soap	7	323,000	84	443,450
Salt and Bromine	6	139,000	90	166,557
Safes, Fireproof	4	100,000	127	143,000
Steam Pumps	3	85,000	60	110,000
Stained Glass	4	75,000	50	90,000
Show Cases	4	40,000	41	97,000
Saw Mills and Box Factories	4	45,000	80	210,000
Saw Mills and Barge Builders	11	185,000	330	1,050,000
Sash, Door, Box Factories, and Planing Mills	10	240,000	320	680,000
Tanners	14	1,190,000	345	2,183,000
Tinners	15	328,000	276	868,000
Tobacco, Plug and Smoking	3	95,000	123	305,000
Upholsterers	19	130,000	123	457,000
White Lead and Linseed Oil	8	1,200,000	306	1,672,000
Woolen Mills	3	100,000	50	100,000
Totals	1,380	$105,401,481	85,436	$145,721,619

ALPHABETICAL SUMMARY

Showing wholesale jobbing trade, number of establishments, capital invested, number of hands employed, and value of sales, etc., etc.

BUSINESS INTERESTS.	No. of Establishments	Capital Invested.	Hands Employed.	Value of Sales.
Agricultural Implement Dealers	10	$75,000	50	$416,000
Anthracite Coal	4	40,000	20	70,000
Boots and Shoes, Wholesale Dealers	19	725,000	85	2,305,000
Book Dealers and Publishing Houses	16	285 000	108	1,025,000
Cement	5	30,000	14	80, 00
China, Glass, and Queensware	15	140,000	35	367,000
Carpets	8	275,000	100	705,000
Cloths and Cassimeres, Wholesale	6	220,000	40	73[illegible],500
Cattle, Live Stock	20	....	..	18,251,852
Dry Goods, Wholesale	9	1,800,000	187	5,394,000
Drugs, Wholesale	9	550,000	73	1,262,000
Flour Dealers, Wholesale	13	....	..	1,881,700
Grocers, Wholesale	30	3,102,000	263	11,950,000
Glassware, Lamps, etc., Wholesale Dealers	7	250,000	80	1,250,000
Grain	20	....	..	2,551,000
Hats, Caps, and Furs, Wholesale	6	160,000	41	476,000
Hardware, Wholesale	13	675,000	140	1,600,000
Iron in Pigs, Commission Merchants	18	... ..	..	6,000,000
Iron, Scrap, Dealers	27	173,000	81	1,750,5 0
Jewelers, Wholesale	8	190,000	75	627.000
Liquor Dealers, Wholesale	58	750,000	180	1,892,100
Leather and Shoe Findings	16	185,000	57	491,000
Millinery, Wholesale	4	150,000	53	72[illegible],800
Merchandise Brokers (Grocers)	7	....	..	6,412,000
Notions and Fancy Goods, Wholesale	11	146,000	53	520,000
Pianos and Organs	8	150,000	51	486,700
Produce and General Commission	31	....	154	2,600,000
Rags and Paper Stock	5	....	78	175,000
Saddlery Hardware	4	150,000	40	400,000
Scales	3	65,000	30	160,000
Sewing Machines	13	... .	180	500 000
Tobacco and Cigars, Wholesale	12	300,000	75	1,000,000
Wall Paper	9	130,000	60	240,000
Totals	444	*$10,706,000	2,353	$74,303,152
Manufacturing Industries	1,380	$105.401,481	85,436	$145,721.619
Wholesale Jobbing Business	444	10,706,000	2,353	74,303,152
Totals	1,824	$116,107,481	87,789	$220,024,771

* NOTE.—The cattle, grain, and flour dealers, merchandise brokers, produce and general commission merchants, and sewing machine agents, while using a large amount of capital in their various business, are not included.

THE LIFE-LINE PROJECTOR.

WE recently had occasion to record some very successful experiments which were made with the life-line projector of Messrs. Evans & Low, at the Glengall Ironworks, Millwall, in the presence of the Admiralty authorities and others, and at which we were also present. This apparatus, which is now being exhibited at the Naval and Submarine Engineering Exhibition, we illustrate. This gun is carried on board ship, and, in case of stranding, a line is fired on shore. The gun is 2 feet long, with a 2½-inch bore, and is so constructed that the line passes out of the back end of the gun, coming through a small tube, A, which is fixed down the center. The line, with the exception of the short piece which goes down the tube, is coiled in the form of a cop, and placed inside a steel canister, D. The gun is then loaded, and canister rammed home, a hole running right through it and cop, to allow the small tube to pass through. The light, E, is fixed to the top of canister to show its direction when used in the dark, igniting by friction as soon as gun is discharged. The gun is then fired. The canister is propelled in the desired direction, leaving the line streaming behind it as it uncoils itself from the inside. Other cops, G, are bent on to the line at back end of the gun, in case a greater length of line should be required than contained in the one cop, and to prevent losing the end of it. The distance to be covered is simply a question of size of gun, canister, and charge of powder. The above size is powerful enough for any ordinary circumstances. The one tried, made of scrap iron, was sent to Birmingham, and there tested in the thorough manner in the proof house. The line is made of flax, about 3-16ths of an inch in diameter, and will carry 200 lb. dead weight with a length of 6 or 7 feet. This gun would, in case of emergency, be the means of saving valuable lives and property. The action is very simple, and requires little or no instruction to work it. In case of ships driven on the rocks in out-of-the-way places—perhaps miles away from the life boat or coastguard, or any apparatus on shore to assist them—it will be of incalculable value, for with merely the assistance of a few men on shore to haul the line in after the canister has been fired to them, in a very short time they can have the hawser fixed and reach the shore, where otherwise there was no chance of saving them or gaining any communication with the shore. In foul weather it can be used as a means of passing a tow rope from a ship to a tug boat, when unable to get alongside, by simply firing a line over the tug and thus getting communication. It will also act as an ordinary signal gun, by simply firing it without the line and canister; and by fitting harpoons to the canister top it can be used for whale shooting. The gun can be mounted on a tripod stand, H, H, H, as seen in Fig. 1 of our engraving. Sockets, I, as shown in plan at Fig. 2, and in elevation at Fig. 3, are also supplied with it, bored to receive the swivel, J, on the gun. These sockets can be placed, say, two on the poop, two on the forecastle, and two amidships, or at the convenience of the captain, so that the line may be fired in any direction, no matter what position the vessel may be in. The contrivance is a most ingenious and meritorious one, and will doubtless find its way rapidly into the naval service.—*Iron.*

LIFE-LINE PROJECTOR.

VERITY'S COUPLING SLEEVE.

THE object of the sleeve shown in the accompanying cut is to couple two shafts which form a certain angle with respect to each other.

The two extremities of the shafts, A and B, are hollowed out so as to receive a steel sphere, C, which forms a ball and socket joint; so that whatever be the angle made by the two shafts, their respective axes pass through the center of the sphere.

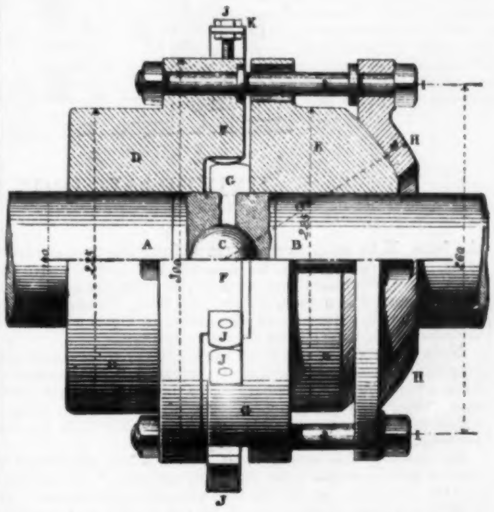


FIG. 1.—Longitudinal Section and Elevation.

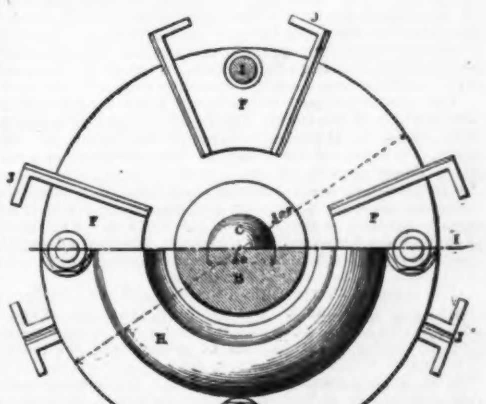


FIG. 2.—End View.

VERITY'S COUPLING SLEEVE.

Upon the shaft, A, there is keyed a cast-iron piece, D, which is fixed by means of six bolts, I, to a sort of cap, H, through the center of which passes the shaft, B. Upon this latter there is a piece, E, spherical at one end and fitting accurately within the cap, H. The two pieces, D and E, have projections in the form of sectors, F and G, which adjust themselves with each other as in a toothed coupling-sleeve. These projections carry small pieces of steel, J, which are rounded externally so that a contact may always take place when the shafts are inclined.

This sleeve is no doubt very simple and very strong, but it is capable of coupling only such shafts as form a very obtuse angle.

UNIVERSAL MACHINE FOR WORKING METALS.

The effort has been made to combine in a single machine, as has already been done for wood-working, the different apparatus which serve for working metals, the object being to notably reduce the expense of the tool equipment of small manufacturing concerns. The accompanying Figs. 1, 2, 3, and 4 represent a machine of this kind, invented by Messrs. Jentzsch & Zwanziger, of Vienna, which will cut bars and plates, punch, upset, bend, forge, and rivet. The different parts of it are condensed into as small a space as possible, without affecting the great simplicity of the general arrangement, and without preventing facility of access to the parts. Moreover, the different apparatus are so placed on the same frame as not to materially interfere with one another, a condition which is neglected in many combined machines of the same class.

The apparatus consists of two two-armed levers, A *a* and B *b*, placed between two uprights, C, with their lateral faces, X, in contact. The rotary axis of these levers is *e*, which may be introduced into the different apertures contained in the faces, X, in order to modify at will the length of the lever arms. The lower arm, A, is connected by a bolt, C, with the lever, D, which establishes a connection with the upper arm, B, by means of two rods, H, and the bolts, C_2 and C_3. The lower rounded extremity of the lever, D, slides either on a metallic plate, *s*, or on one or several rollers.

Near the faces, X, are placed the knives or shears, *h*, in corresponding grooves worked in the levers, A B. These knives have a variable profile, according to the nature of the piece upon which they are to act. The object is held in a horizontal position by means of the appendage, E, which, for this purpose, is provided with a clamping screw.

By means of this arrangement, only flat iron can be cut in bars or profile, because the arms and uprights, C, do not permit the object to be moved forward, and consequently the length that can be cut is limited by the length of the knife. Another arrangement is employed for cutting plates, and this consists of two jaws, F and G, of peculiar form, which revolve on an axle, *i*, fixed to the upright, C. In the direction of the edge of the knife, *f*, attached to the jaws, F, there is chamfered in the posterior part of the piece, F, a groove which permits of moving the plate to be cut in the direction of the arrow, f_2. The two jaws are connected by their arms, F_1 G_1, with the levers, *a* and B, and thus receive their motion.

The punching apparatus is adapted to the strong extremities, *a* and *b*, of the levers. The metal removed by the punch falls outside of the machine through the channel, *n*. The plate, *c*, is so placed that it may be arranged at will as a matrix. This apparatus can easily be transformed into a stamp for saw-teeth, by placing on the lower lever, *b*, a support or guide for the blade of the saw, and employing a matrix and punch adapted to the form of the tooth to be produced. The forward movement of the blade, which is effected by hand, is regulated by a bolt. This arrangement also serves for cutting out the teeth of circular saws.

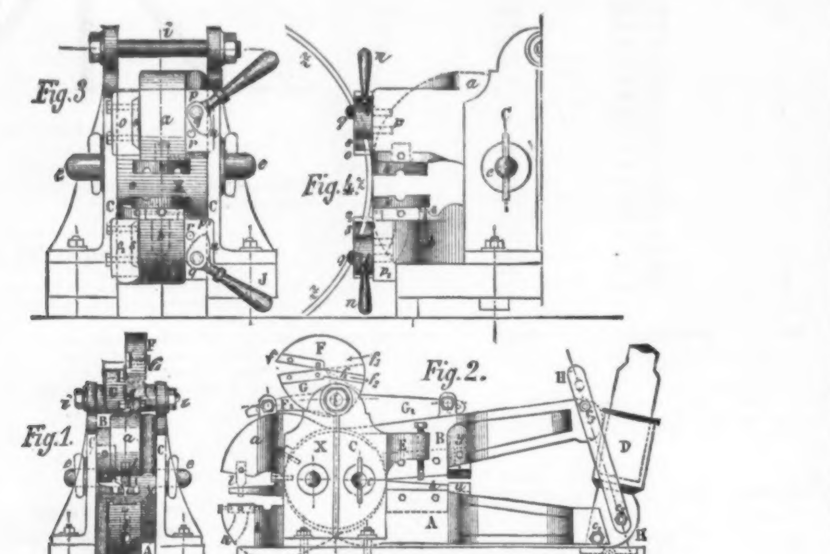
The apparatus for upsetting, forging, and compressing are shown in Figs. 3 and 4. For upsetting, the levers, *a* and *b*, carry on the two sides cheeks, *o p* and o_1 p_1. The cheeks, *o* and o_1, receive, in projections of proper size, the toothed steel plates, *s*, while the bolts, *q*, introduced into the cheeks, receive toothed compressing pieces, *n*. These latter have a concentric form, so that, when they are turned by means of their winches, the space included between the toothed surfaces may be diminished at will, and the piece placed between them may be held fast or disengaged. In order to allow of objects of variable size being held, the jaws, *n*, may be located at different heights in the holes.

For forging and compressing, the swages, *k*, are substituted in the jaws, *a* and *b*, for the punch and matrix.

The apparatus for riveting is adapted to the plate-shears, F G (Fig. 2), and may be employed either alone or in combination with the latter. The groove, *f*, should in this case be much deeper, in order that juxtaposed, and consequently thick, pieces of metal may be put into the machine. At the front extremities of the jaws there are projections for receiving the tools ordinarily employed in riveting. The two pieces of plates that are to be riveted together are previously punched, and then shoved into the machine, the upper plate in the direction f_3, and the lower in the opposite direction, f_2, through the groove f_1. The two plates reach the extremities of the jaws together, and the rivet is driven home by lowering the lever, *D*.

In the levers, *a* and *b*, there may likewise be substituted for the swage and matrix an apparatus for bending. In the arrangement for cutting, there have also been adopted at *y* (Fig. 2) small knives, *t* and *u*, for cutting out iron while hot that could not be cut cold by the knives, *h*.

As before stated all these arrangements can be united in a single machine without one interfering with the others; yet it is very easy by screwing or un-screwing a few bolts to put in place or take out one or several of them.



UNIVERSAL IRON-WORKING MACHINE.

STOPPING MECHANISM FOR SPINNING FRAMES.

During the last three or four years, the genius of inventors has been much occupied over stopping mechanisms to be adapted to spinning frames used in the manufacture of thread of mohair, alpaca, and other products, made from crude materials of great value. Such threads are produced on throstle frames, and it is not without interest to examine into the reason why a stopping mechanism is desirable for a loom employed in making threads from costly materials, and what the *role* of such a mechanism is.

The general arrangement of the frame for finishing threads is as follows: The slub or coarse roving is first unwound from the bobbin by a pair of feed cylinders, which are usually channeled, the upper cylinder being pressed against the lower by springs or weights. These feed cylinders cause the slub to pass on to the drawing cylinders, which, having at the surface a velocity greater than that of the feeders, draw out the slub to the desired degree before the torsion is given it by the flier. In the space between the cylinders and feeders, where the slub is drawn, it is led between light wooden cylinders called guides, whose sole *role* consists in supporting the slub. The upper drawing cylinder is covered with leather; the lower is fluted. When a thread breaks it is these two cylinders which cause the greatest inconvenience; for the slub continues to be furnished by the feed cylinders, and reaches the drawing rollers, upon one of which (usually the one covered with leather) it doubles; and such doubling continues until the operator remarks that a thread has broken, and until it is in his power to attach it again.

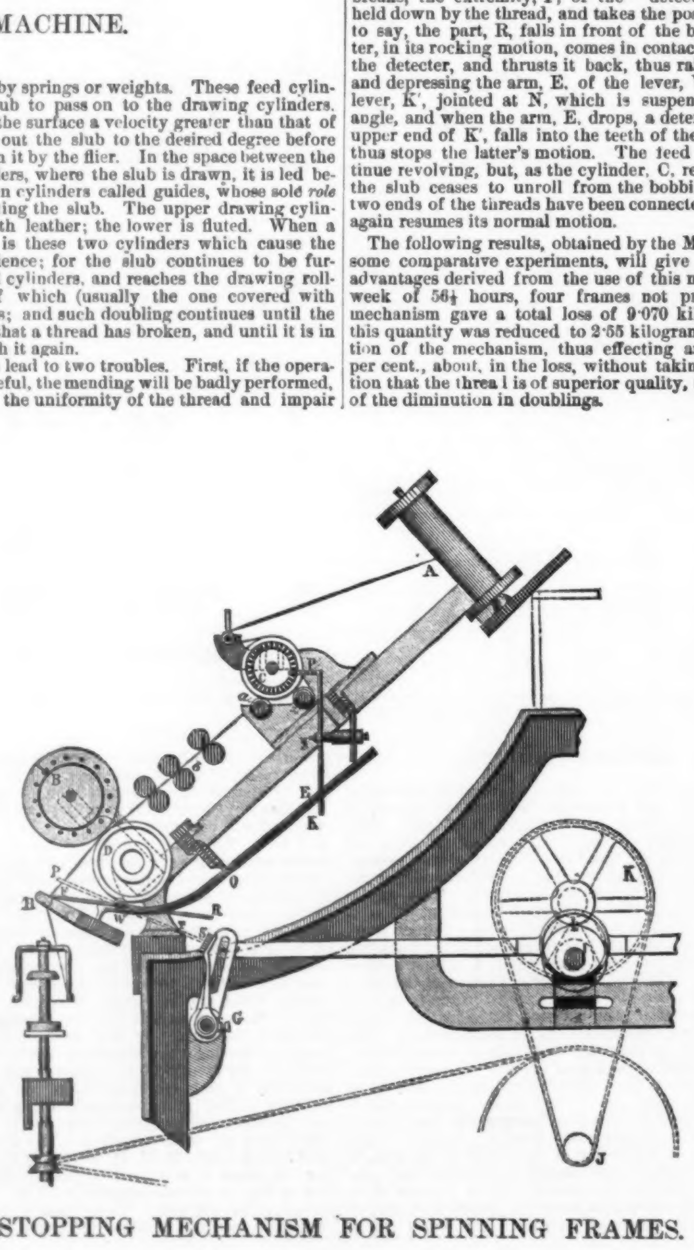
These doublings lead to two troubles. First, if the operator is not very careful, the mending will be badly performed, and hence destroy the uniformity of the thread and impair its value. Before attaching the ends of the threads, it is necessary that the whole portion which has accumulated on the pressing roller shall be removed, otherwise there will be a doubling in the thread at the spot where it is repaired. In the second place, it must not be lost sight of that for every pound of material that accumulates on the cylinder there corresponds a loss of work expended in the preceding operations for bringing the materials to this state. Such a loss is very important, even on the supposition that the doublings have the same value as the crude material—which is far from being the case.

As a remedy for these troubles, it is necessary to add to the machine a stopping mechanism, whose action shall arrest the motion of the slub furnished by the bobbin whenever the particular thread breaks which corresponds with such bobbin. A slubbing frame may contain several hundred spindles, but the stopping mechanism should act only upon those whose thread is broken; and herein lies the difficulty to be overcome in the problem. It is clear that it would be absolutely useless, if not impossible, to stop all the spindles when one of them ceased to operate properly. The mechanism shown in the accompanying cut was invented by Messrs. Crossley & Sutcliffe, and is applied by Messrs. John Crossley & Son in their establishments at Halifax.

The combination adopted is ingenious, and simpler than it would seem to be from the cut. The drawing cylinders, B D, and the guides, *b*, remain the same as in ordinary looms; and the feeders, situated generally one above the other, are here placed side by side, at a certain distance from one another, as shown at *a a*. The part of the cylinders which serves for feeding may be either fluted or plain, as may be wished, and the cylinders themselves are surmounted by a heavier, plain one, C, whose surface is provided with notches or teeth. This cylinder is movable, and is made to revolve by the friction of the feeders, *a*. The slub winds over a great portion of the circumference of the cylinder, C, and the friction thus produced is sufficient, although the surface is plain, to unroll from the bobbin, H, the quantity of slub desired, when the cylinder, C, revolves in consequence of the rotary motion given the feeders, *a*.

The table, H, instead of being hinged to the loom, is rendered separate for each spindle, and is mounted at the extremity of the lever, E W, which has its fulcrum at O. The part W, of this lever, situated to the side of the table, H, is heavier than the other part, E, and assumes of itself the position shown in the cut, and which corresponds to the normal operation of the apparatus. A very light piece, F R, of wire, called the "detecter" (because it acts when there occurs an interruption in the thread), is jointed to this lever at the point, W. Its part, R, is a little heavier than its other extremity, F, over which passes the thread in depressing it toward the table, H; while the part, R, is raised, and remains in that position when operations are proceeding regularly. An eccentric, L, set in motion by the axle, I, actuates a rocking shaft, G, carrying a bar, S, which extends over the entire length of the loom. When a thread breaks, the extremity, F, of the "detecter" is no longer held down by the thread, and takes the position, P T, that is to say, the part, R, falls in front of the bar, S, and the latter, in its rocking motion, comes in contact with the end of the detecter, and thrusts it back, thus raising the arm, W, and depressing the arm, E, of the lever, W E. There is a lever, K', jointed at N, which is suspended at a certain angle, and when the arm, E, drops, a detent, *p*, fixed at the upper end of K', falls into the teeth of the cylinder, C, and thus stops the latter's motion. The feed cylinders, *a*, continue revolving, but, as the cylinder, C, remains stationary, the slub ceases to unroll from the bobbin, A. When the two ends of the threads have been connected, the mechanism again resumes its normal motion.

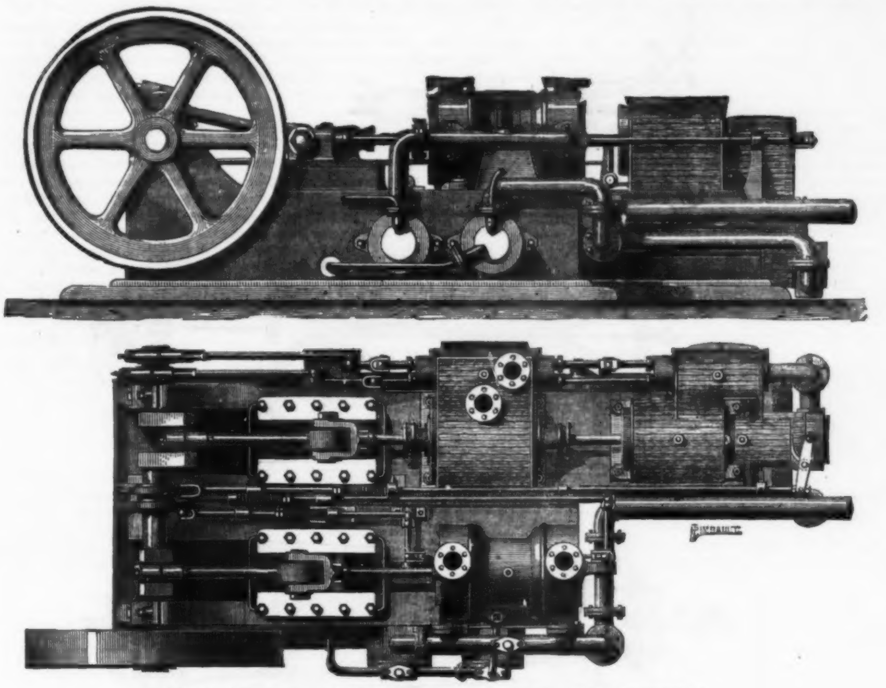
The following results, obtained by the Messrs. Crossley in some comparative experiments, will give some idea of the advantages derived from the use of this mechanism. In a week of 56½ hours, four frames not provided with the mechanism gave a total loss of 9·070 kilogrammes, while this quantity was reduced to 2·55 kilogrammes by the addition of the mechanism, thus effecting an economy of 70 per cent., about, in the loss, without taking into consideration that the thread is of superior quality, as a consequence of the diminution in doublings.



STOPPING MECHANISM FOR SPINNING FRAMES.

IMPROVED REFRIGERATING MACHINE.

OUR engraving shows a cold dry air machine exhibited by Messrs. J. & E. Hall, of Dartford, at the recent naval exhibition, London. In this machine the steam cylinder and



IMPROVED REFRIGERATING MACHINE.

air expansion cylinder are placed in line with each other on one side of the bed plate, while the air compressing cylinder is placed on the opposite side, the power to work it being transmitted through the crank shaft. The compressing cylinder is double acting and is fitted with inlet valves worked by cams on the crank shaft as shown. From this cylinder the air heated by compression passes through the condensers arranged on the base plate, and thence enters the expansion cylinder. This latter cylinder has a piston fitted with a trunk on one side, and is single acting. In the machine exhibited the steam cylinder is 10 in., the compression cylinder 10 in., and the expansion cylinder (single acting) 11 in. in diameter, the stroke in all cases being 12 in. The machine is run at 114 revolutions per minute, and delivers 4,500 cubic feet per hour, at a temperature of about 40° below zero, Fahrenheit. It is being shown at work in connection with a cold air chamber of 730 cubic feet capacity. Messrs. Hall have fitted their refrigerating machines on three of the Peninsular and Oriental Steam Navigation Company's steamers, and they are about to fit up two other steamers of the same company. Their machines are also in use by the London and St. Katherine's Dock Company and the Orange Slaughtering Company.—*Engineering.*

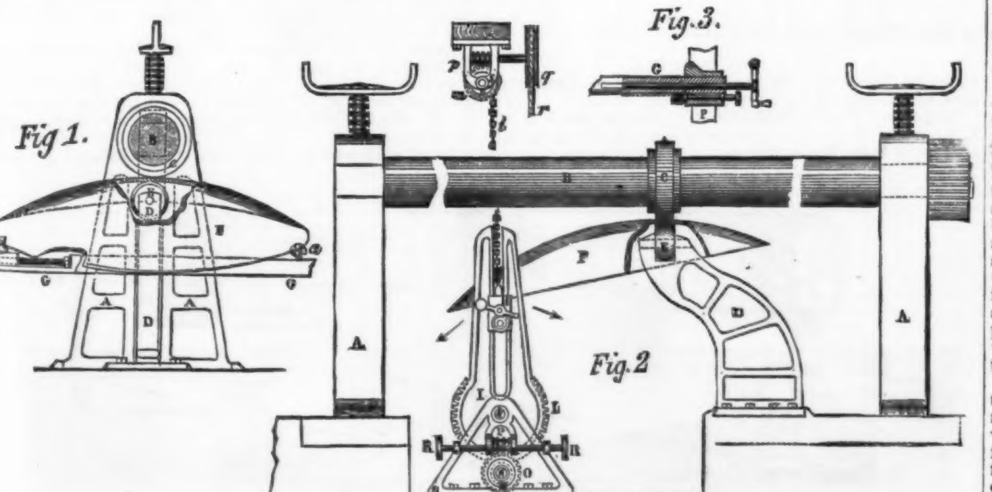
MACHINE FOR BENDING IRON PLATE.

IN the machine constructed by Mr. Hesse, of Heddernheim, near Frankfort-on-the-Main, the plate passes between a cylindrical disk and a roller, with a curved surface that may be considered as a portion of a sphere. By means of special arrangements, the plate may be moved in all directions, so as to give it a spherical form.

The apparatus is represented in Figs. 1, 2, and 3. Between the uprights, A, A, revolves a shaft, B, in bearings that may be lowered or raised by means of a screw, in a manner already well known. To this shaft is affixed a disk, C, whose surface is cylindrical, or has a slightly concave form. Exactly underneath the disk, C. there revolves a disk or friction roller, E, which is supported by the upright, D, and the surface of which bulges out in the form of a sphere. The circular plate, F, to be rolled is placed between the disks, C and E. When the shaft, B, is caused to revolve, and C is pressed against E, these two parts, in case they are not exactly at the summit of the curve of the plate, F, roll the latter spirally; and, during this operation, the plate is rendered thinner and both its curve and surface are rendered greater. If the disks, C and E, were exactly at the summit of the curve, their motion would take place in the direction of the great circle of which the curved plate forms a segment. The rolling is conducted by the cold process, and in order that it may be performed with the exactness and regularity desired, the plate must not be left to itself during the operation of rolling, but must be supported and guided. For this purpose, the plate rests on two rollers, *a*, whose position on a horizontal cross-piece, G, may be displaced in a longitudinal direction by means of a rack and a helicoidal wheel. The extremities of the cross-piece, G, pass through heads, H, which may be raised or lowered in the slots of the uprights, I. For this purpose, each of the heads, H, carries a ring, from which is suspended a chain, *l*. These chains are wound around drums, *m*, whose axle is movable in bearings, *s*, affixed to the ceiling. One of the extremities of the axle of the drums carries a helicoidal wheel, *o*, whose screw, *p*, rests on the same axle as the pulley, *q*. When this latter is made to revolve by means of the cord, *r* (this being done by hand), the two heads, H, and, consequently, the cross pieces, G, are raised or lowered parallel with each other in the slots, I.

Finally, the cross-piece, G, is also movable in a third direction, the two uprights, I, being capable of oscillating simultaneously around one axis, K, in common, which revolves in bearings affixed to the supports, S. Each of the slots, I, is provided with a crown wheel, L, with which engages a pinion, M. The two wheels, M, rest on the axle, N, which may be made to revolve by means of the screw gearings, O, P, and the winches, R.

This mobility of the cross-pieces, G, in three directions, and that of the rollers on the cross-pieces permits of giving the curved plate any position whatever.



MACHINE FOR BENDING IRON PLATE.

UNIVERSAL MOULDING MACHINE.

THE use of moulding machines is tending gradually to replace moulding by hand in iron foundries, not only because it gives a product of better quality whose forms and dimensions remain exact and regular, but also because it diminishes the cost price by considerably increasing the production.

So in recent years there has appeared a series of new or improved apparatus of this nature, designed either for the moulding of special objects (such as cylinders, wheels, etc.), or for general use. Among these latter, there was shown at the exhibition of new German inventions, held at Frankfort in 1881, a universal moulding machine designed by Messrs. Gallas & Aufderheide, and presenting considerable analogy with that of Messrs. Sebold & Neff.

The different parts of which the mechanism of this machine consists are arranged vertically one above another in a frame formed of a foundation plate and four columns of wrought iron. At the base is first the pressing apparatus, which carries the rails with the car or movable moulding table; above this, the bed plate with the turning mechanism; then, the pressing frame with the leveling mechanism; then, a movable pressure cover, with the pressing block, and a reservoir of coarse sand; and, finally, a reservoir of moulding sand with a mechanical sifting apparatus for spreading the sand over the mould.

The operation is conducted as follows: First, there is fixed on the bed-plate which carries the pattern the corresponding half of the moulding frame. By pushing the pressure cover back, enough moulding sand is caused to flow from the reservoir to entirely cover the pattern, and then, by means of a scraper, the moulding frame is filled to the top with coarse sand from the reservoir. The workman then pulls forward the pressure cover, with its pressure block adapted to the nature of the pattern; raises, by means of the pressing apparatus, the pressure table and its car, along with the turning mechanism, bed-plate, and frame; and pushes them against the stationary pressing

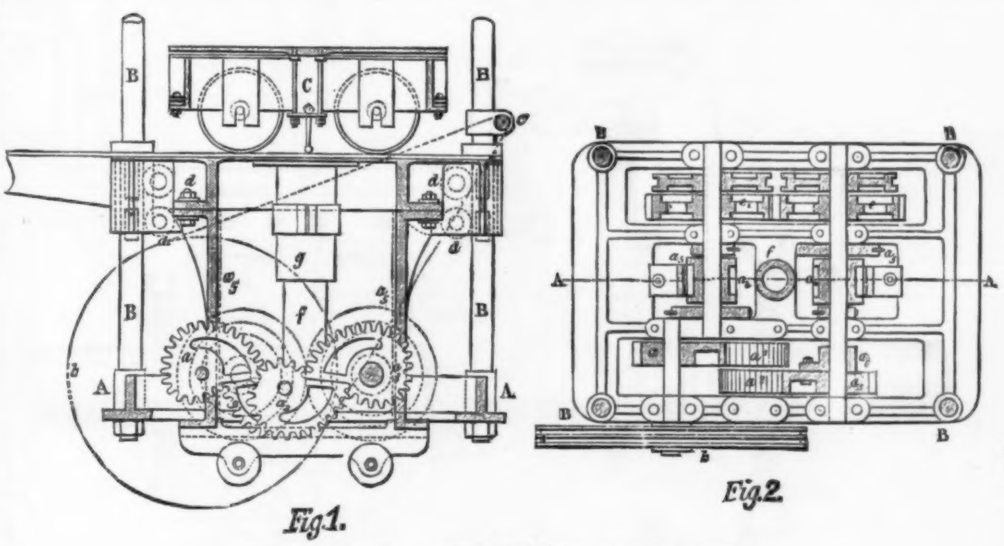


Fig1.

Fig2.

UNIVERSAL MOULDING MACHINE.

block, in order to compress the sand. The whole is then lowered again until the car is free; the latter is then shoved to one side, and the sand above the frame is struck and leveled by means of the strickle affixed to the pressing frame. After loosening a latch, the bed-plate, along with the frame, is revolved 180 degrees by means of the turning mechanism; then the car is pushed under the frame, and raised until the latter rests upon it; and afterward, the bed-plate is separated from the frame by lowering several times (first slowly, then more rapidly) the pressing apparatus. After drawing out the car, and turning the bed plate around, the operation may be begun anew.

Among the mechanisms which serve to effect these different motions, the apparatus by which the pressing table is made to rise and descend is especially interesting. This is represented in plan and elevation in Figs. 1 and 2. The pressure is here given by means of a rack movement a_4 a_5; but, since during the first period of the ascensional motion, there is to be raised only the weight of the pressing table and car, balanced by counterpoises, and since afterward the bed-plate (also balanced) has to be raised with its turning apparatus, as well as the frame with the sand, and finally, since, the motion continuing, the sand has to be compressed with a constantly increasing pressure, the power necessary increases continuously from the beginning to the end of the ascending motion. For this reason the constructors have placed between the point of application of power by the workman (the winch on the axle, *c*) and rack gearing a transmission whose proportions are continuously modified.

While others have obtained such change of pressure from the speed by the use of an eccentric, motion here is transmitted by a chain from a small pulley on the axle, *c*, to the wheel, *b*, on whose axle there is a small toothed arc, *a*, and from here to the toothed arcs, a_1, a_2, and a_3. First, as the figure shows, in the two pairs of arcs the large radius of the driving wheel engages with the short radius of the wheel driven, and there is thus obtained an acceleration of the motion; but, the rotary motion continuing, the radii of the two driving wheels diminish, while those of the driven

wheels increase, so that the ratio of transmission approaches at first 1 : 1. After this, however, there occurs a slackening of the motion which becomes more and more pronounced.

On the axis of the arc, a_2, there is a rack gearing, a_1, and a toothed wheel, *e*, which engages with the toothed wheel, e_1, and thus transmits motion to a second rack gearing, a_3. In order that the four wheels, *a*, a_1, a_2, a_3, may be exactly adjusted in their positions, a_3 is not fixed directly upon the axle, but is connected with it by a coupling, a_4. The pressing table is guided against the four iron rods, B, partly by means of sixteen friction rollers, *d*, and partly by the two cylinders, *f* and *g*, which engage with one another.

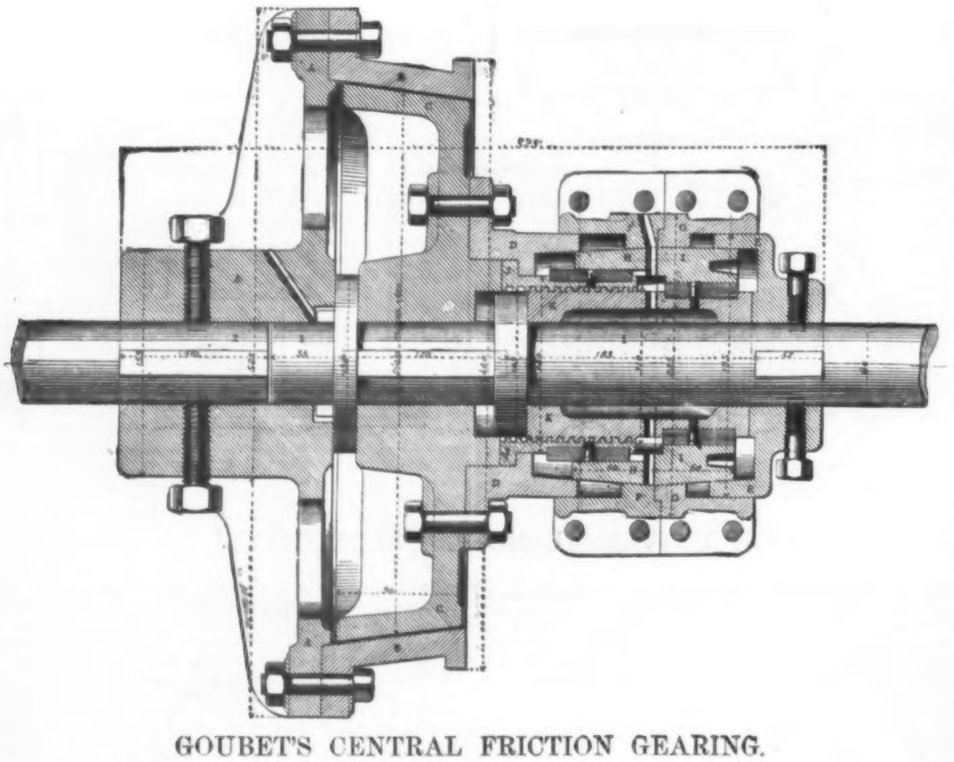
The rotation of the bed-plate, balanced by weights, is effected by means of a winch, and a pinion, which engages in a wheel toothed internally. Besides, upon the axis of the bed-plate there rest at the two sides small pulleys, that may be rendered movable or immovable on their axle by means of screws. Over each of these pulleys there runs a chain, whose upper extremities pass over rollers, and carry the counterpoises. Each of the weights is provided beneath with a rod, which is guided into a projection from the corner of the pressing cover; and each rod has a regulating ring whose position determines the lowest point to which the bottom plate can descend.

In moulding frames that are not very high, these two small pulleys may be loose on their axles, and then they exert no action when the bottom plate is turned. But when the frames are high, the pulleys are tightened on their axles by screws, so that they revolve equally, and must raise the bottom plate with the frame, thus giving sufficient space to allow the car to pass under the frame. The counterpoise suspended at the other extremity of the chain stretches the latter, and prevents it from jumping from its roller.

Generally, the bottom plate is arranged in such a way that only half the frame is placed on it at once. Yet, it is possible to make plates that will permit of preparing the upper and lower part of the mould at the same time, one alongside the other, on one and the same plate; and a machine of this kind was shown at the Frankfort Exhibition. Naturally, in such a case, the height of the two parts of the mould must be the same, otherwise their use would not be practicable. The two halves of the mould are united, and connected with each other very firmly by peculiar arrangements.

CENTRAL FRICTION GEARING.

THE principle upon which this apparatus is based is as follows: If we place a key upon the head of a screw and upon its nut, and, on turning them always in the same direction, if we stop the screw, the nut, in revolving, will advance; but if, on the contrary, we stop the nut and cause the screw to revolve (supposing it impossible for the latter to move longitudinally), the nut will recoil.



GOUBET'S CENTRAL FRICTION GEARING.

The shaft, 1, which carries the longitudinally sliding cone, C, is to communicate motion to the shaft, 2. To this latter there is affixed a disk, A, carrying a conical box, B. To the large cone, C, there is affixed a conical box, D, which revolves with it. Into the part left free internally there is inserted the shoulder of a bronze nut, J, which is designed to cause the cone, C, to follow the motions of the nut, F; the latter being screwed into the threaded bush, K, which is loose on the shaft, 1. To this nut is keyed a cone, H, which is capable of sliding on it. To the bush, K, there is likewise keyed a cone, I, capable of sliding on it. The whole is inclosed within an immovable conical box, in two pieces, F and G, which rests on the one side against the conical box, D, and on the other against the conical box, E, which is affixed immovably on the shaft, 1. To this covering there is attached a lever for maneuvering.

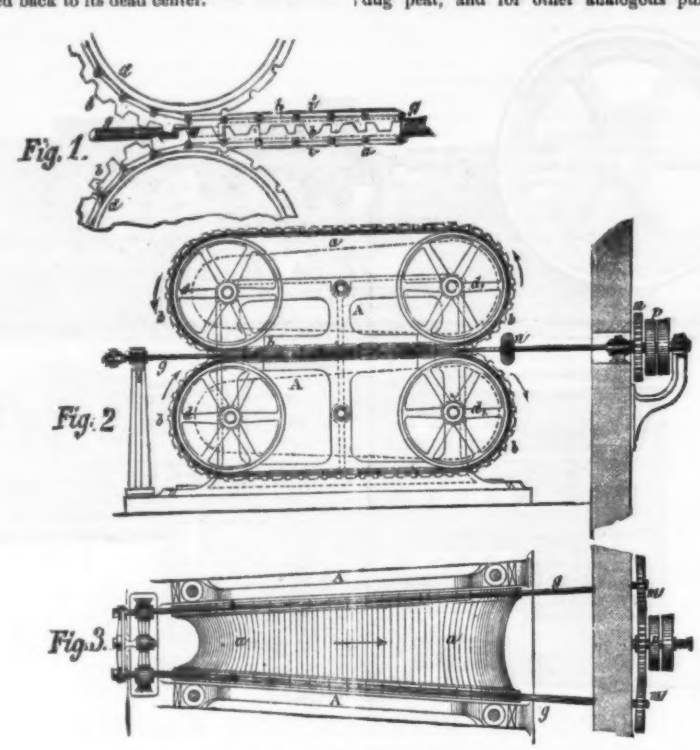
Let us suppose, now, that shaft 1 is revolving, and that the cone, H, with the nut, J, forms an ordinary nut, of which the threaded bush, K, and the cone, I, represent the screw. It is evident that if the outside covering, F G, be moved to the left by means of the lever, there will occur a thrust on the cone that slides on the bush, K; and, that this will push the cone, H, which, sliding on the nut, J, will come in contact with the conical box, D. The latter will carry along by friction the cone, H, which in turn will carry along the bronze nut, J, that becomes screwed upon the bush, K; and the latter will be held immovable through the friction that the box, F G, exerts on the cone, I. The nut, J, in moving forward will carry along the large cone, C, by means of its shoulder piece, until it comes in contact with the conical box, B, and a gearing is effected; after which the lever is shoved back to its dead center.

To ungear: on carrying the box, F G, to the right, a pressure is brought to bear on the cone, H, which, in turn, pushing against the cone, I, puts the latter in contact with the conical box, E. The bush, K, then revolves, while the nut, rendered immovable by the box, F G recoils and brings about the ungearing. The maneuvering lever is then shoved back to the dead center.

The cone, C, has an inclination of 8°, and the cones, H and I, have one of 5°. The apparatus is the invention of Mr. Goubet, of Saint Denis, France.

VON GRASS-KLANIN'S STEEL BAND PRESS.

A NEW form of press has been invented by Mr. Von Grass-Klanin for expressing water from beet-pulp, freshly dug peat, and for other analogous purposes. The ap-



STEEL BAND PRESS.

paratus, which is shown in Figs. 1, 2, and 3, has for its principal part bands of steel, *a*, which are arranged alongside of one another so as to form two endless belts. These steel bands are united into a continuous piece by means of jointed pieces, *b*, constituting a sort of chain. These pieces, which form the edges of the belts, inclose the extremities of the steel bands (whose length is uniform) without depriving them of their flexibility. In order that they may be guided along the sides of the frame, A, the pieces, *b*, are provided with appendages, *i*, and, besides, are fashioned into the form of teeth so as to engage with each other, and constitute, by their union, nuts surrounding the axles, *g*, which are situated at a certain angle with respect to each other. Above and below these axles are the driving pulleys, *d* and d^1.

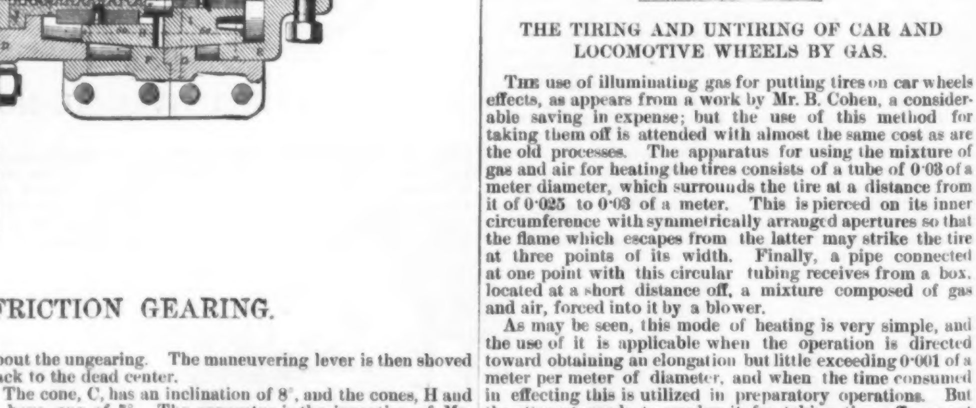
The result of such an arrangement is that the steel bands on moving from left to right, as seen in Fig. 1, pass from a much curved form to one that becomes straighter and straighter. Consequently, the free space between the endless belts, and in which the pressure is exerted, possesses a section which continues decreasing from left to right.

The control of the apparatus is obtained by means of the pulley, *p*, and the toothed wheels, *m*, which communicate a rotary motion to the axles, *g*, whose longitudinal displacement is prevented by a bearing, *n*. However, for the purpose of preventing the somewhat excessive friction of the screws, motion might be given directly to the pulleys, *d*. The press, moreover, as a whole, appears capable of receiving some future improvements; yet, such as it is, it may be considered as an apparatus easy of repair.

THE TIRING AND UNTIRING OF CAR AND LOCOMOTIVE WHEELS BY GAS.

THE use of illuminating gas for putting tires on car wheels effects, as appears from a work by Mr. B. Cohen, a considerable saving in expense; but the use of this method for taking them off is attended with almost the same cost as are the old processes. The apparatus for using the mixture of gas and air for heating the tires consists of a tube of 0·03 of a meter diameter, which surrounds the tire at a distance from it of 0·025 to 0·03 of a meter. This is pierced on its inner circumference with symmetrically arranged apertures so that the flame which escapes from the latter may strike the tire at three points of its width. Finally, a pipe connected at one point with this circular tubing receives from a box, located at a short distance off, a mixture composed of gas and air, forced into it by a blower.

As may be seen, this mode of heating is very simple, and the use of it is applicable when the operation is directed toward obtaining an elongation but little exceeding 0·001 of a meter per meter of diameter, and when the time consumed in effecting this is utilized in preparatory operations. But the attempts made to employ it for taking tires off are not attended with economy; and this is more difficult of expla-



GAS BLOWPIPE APPLIED TO TIRING AND UNTIRING OF CAR WHEELS.

nation, since the problem is then reversed, it being necessary to produce much heat within a relatively short time.

All practical men who have seen this apparatus work have found that its weak calorific power would prove an obstacle to its general application for untiring, because a slow transmission of heat would be followed by a heating of the center, and that would retard the loosening of the tire so much the longer in proportion as the operation was prolonged. This view of the case has been confirmed by experience; and although the operation has succeeded in a few isolated cases, and after a longer or shorter period of time (25 to 30 minutes, about), it became necessary in these to have recourse to water to cool the center.

The apparatus that we are now about to describe has been studied out in view of all such considerations. But, before entering upon the question, let us say a few words in regard to the gas blowpipe which forms the base of the new apparatus. This consists of two converging cones, the central one of which, A, receives the air at a definite pressure, while the other and external one, B, conveys the gas necessary for the mixture. When the proportions of the gas and air are well regulated, the inflamed, non-luminous jet parts with its blue color and reaches a rose color at about 10 to 12 centimeters, the point whereat resides the highest temperature. A chemical analysis of illuminating gas having a mean composition of

Heavy carbureted hydrogen, C_4H_4	9
Light carbureted hydrogen, C_2H_4	74
Carbonic oxide, CO	13
Carbonic acid and carburets in vapor	4
	100

—shows that it takes 7 liters of air for its complete transformation into carbonic acid.

It is important, then, as regards the performance of the new apparatus, that the quantities of air and gas used be in these proportions.

Let us examine the working conditions of the blowpipes nished the gas requisite to the 30 blowpipes, provided the blower operates under a minimum pressure of 0·14 of a meter and furnishes 2 cubic meters of air per minute, the equivalent of two forge fires.

Let us now examine the apparatus as regards the utilization of heat. Experience shows that in a tire of 0·9 of a meter internal diameter, and a thickness of 0.05 of a meter at the tread, there is obtained in eight minutes an increase of 0·003 of a meter in the internal diameter. A tire of iron or steel, 0·9 of a meter in diameter, and weighing about 210 kilogrammes, is raised to a temperature of 300° in eight minutes.

This apparatus is, in fact, only a rational application of the gas blowpipe, but possesses the advantage over that, as we have stated in the beginning, of giving out in a much shorter time the amount of heat necessary for a definite elongation. By this means we believe there is obtained a much greater amount of effective work with less loss. Finally, the outflow of gas and air may be varied, and thus be applied indiscriminately to the putting on or taking off of tires.

The simple and inexpensive installation of the gas blowpipe; the slight expense of keeping it in order; and the facility that it offers for producing or suppressing instantaneously a heat whose energy may be moderated; as well as the regularity of the heat obtained at every part of the tire, are considerations that should cause it to be employed for the execution of an occasional piece of work that requires but a short time to perform.

Again, the high temperature that is quickly obtained with the apparatus offers, by hastening the operations, an offset in the reduction of manual labor which would justify the use of it even in certain particular cases where the expense attending the use of gas was greater than that connected with the use of charcoal.

AUTOMATIC REGULATOR FOR MACHINES FOR GIVING LUSTER TO THREADS.

In glossing machines whose object is to submit dyed threads to a process of drawing, in contact with steam, in order to give them a peculiar brilliancy and a soft luster, the threads are hung in skeins on the pins A, A¹ (Fig. 1), which are disposed in an iron case closed by steam-tight doors; and the upper pins are suspended from the screw which is to perform the operation of drawing. The threads revolve uniformly around the pins, while the steam is entering through the pipe B, the lower pins being revolved by a belt. Tension has hitherto been exerted by a screw actuated by manual power; but, as there is a special coefficient for the stretching of every sort of fiber, determined by experiment, the tension may easily be effected by the screw by means of an automatic mechanism. For this purpose, Mr. Spindler, of Berlin, makes use of the machine shown in the accompanying Figs. 1, 2, 3, and 4.

The lower pin receives, first, a rotary motion from the driving pulley C, by the aid of a conical gearing; and the shaft D communicates the motion to the barrel E, which is moveable on a spring. Two pinions, F and g, are arranged so as to revolve freely on the shaft of the barrel E and gear with the wheels H and J. Each of them is connected with a wooden cone. The nave L of the wheels H and J forms the front of the screw M. When the barrel E is made to ascend or descend on its axis it carries along by friction the pinion F or the pinion g, or causes the front M to revolve to the left or to the right. The barrel E is held in a ring suspended from the rods N, which pivot on a system of connecting rods O P. The weight of these latter, of the drum E and of the rods, is balanced by a counterpoise, Q. So long as the rod P is neither raised nor lowered, the drum retains its normal position and acts on neither the pinions F nor g; but if it be made to descend the drum is put in contact with the pinion g, the nut L revolves, and the screw M rises.

It next becomes a question of regulating the drawing for a certain length of time, and for this purpose a wheel R, is mounted upon the screw M, and may be displaced whenever it becomes necessary. When the wheel R reaches a certain height, which is fixed in advance, it abuts against the appendage S of the lever T, which pivots at U on the rod O. The extremity of this lever is connected by the rod V W to the bent catch X, whose pivot is at y. This catch, then, has its lower extremity drawn toward the left as soon as the rod V W is raised. The lower extremity of X rests on the upper surface of a stopping mechanism Z, which is arranged as in a ratchet drill; that is to say, between two limiting disks there is a ring which carries the two ratchets, and which is provided with a handle. The rod P of the lever O is screwed into the core of the mechanism Z, and the operator can press the lateral surfaces of the core against the sliding surface of the catch X as strongly as he wishes in order to compensate for the wear of the barrel E. For this purpose it suffices to give the handle of the mechanism Z a backward and forward motion. When, for example, the catch X has slid from the stop Z as a consequence of the raising of the rod V W the rod P becomes free and can rise between the two branches of the hinge-joint y of the catch X. The barrel E is then disengaged from the wheel g. Nearly at the same time that the wheel R lifts the appendage S, the nave of the former acts upon the central part of the rod O and causes it to rise, thus disengaging the drum E from the wheel g, and interrupting the process of

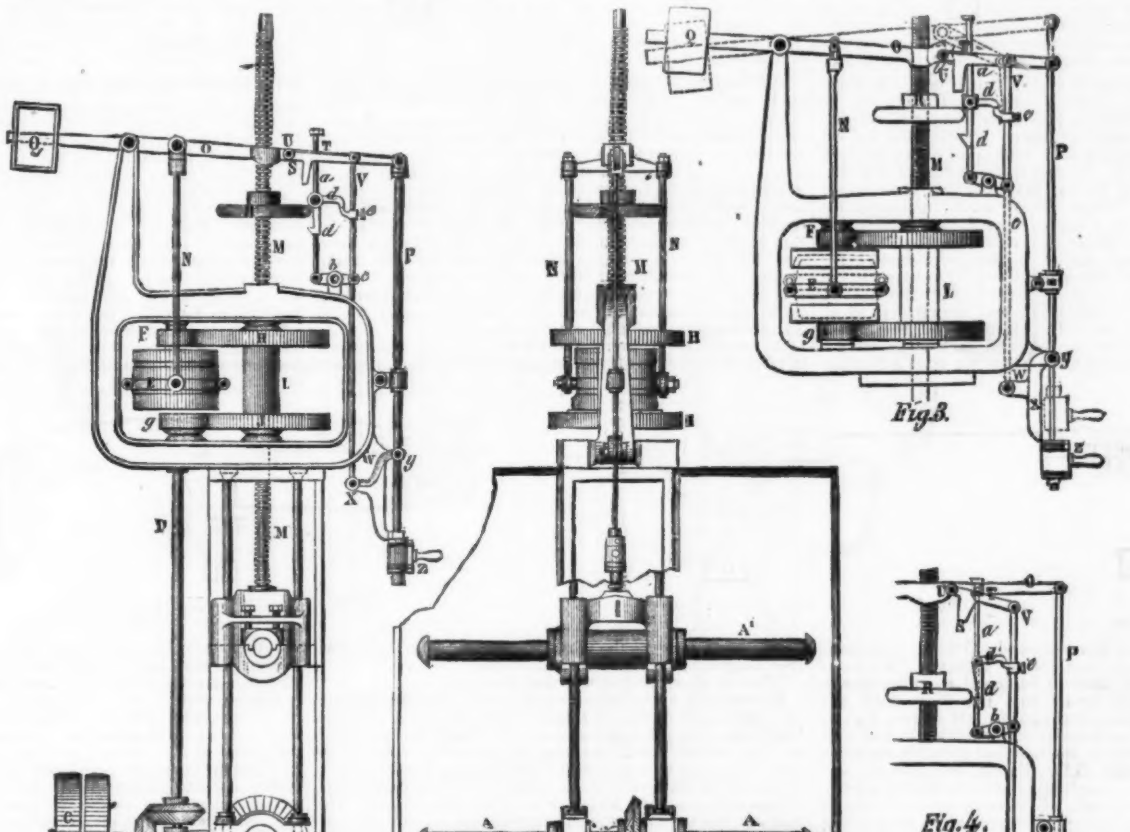


Fig. 2 Fig. 1

AUTOMATIC REGULATOR FOR MACHINES FOR GIVING LUSTER TO THREADS.

of the apparatus for untiring, which is provided with two distinct circular tubings. The external of these, A, receives the air at four points of its circumference, through cocks, R, which are connected with a circular tube 0.05 of a meter in diameter, and which is itself fed by two conduits. The second and internal tubing, B, likewise receives its gas at four points, through cocks, R_1; which are connected with another circular tubing 0·05 of a meter in diameter, fed at two opposite points by gas issuing from a meter under a hydrostatic pressure of 0·04 of a meter. As will be understood the cocks serve only for regulating the outflow of gas and air for the 30 blowpipes, C, comprised in the apparatus.

Observations made during the best conditions of the apparatus' operations have given the following results:

Pressure of air in pipe A (hydrostatic pressure) 0·210 m.
Pressure of gas in pipe B (hydrostatic pressure) 0·008 m.
Discharge of gas per minute, measured by meter, and under a pressure of 0·04 m. . . . . 1 cub. m.

Simple calculations show that on enlarging the diameter of the tires from 0·004 m. to 0·0056 m., and on preserving the same outflow of gas, there may, with a blower, be fur-

drawing. Figs. 1 and 2 show the machine at the moment the screw M is ascending, and during which the catch rests with its lower sliding surface on the stop Z. In order to cause a descent of the screw M the handle of the stop Z is grasped and the latter is raised. At the same time the rod P rises, and the appendage S of the lever T disengages itself from the ring of the wheel R. By virtue of its own weight, increased by that of the V W and of the lever T, the catch X tends to revolve toward the right and to drop of itself below the lower face of the stop Z, when the latter has been raised to a sufficient height. This position is shown by dotted lines in Fig. 3. The barrel E is then in contact with the wheel F, and the nut L revolves in a contrary direction, causing the screw M to descend until it sets in action the second stop-work, which consists of the rods a, b and c. The second bent detent d is connected to the rod a, whose upper extremity plays in a slit in the lever O. The rod V W is common to the two systems of detents.

When the screw M descends, carrying along with it the wheel R, the latter strikes against the tappet of the lower arm of the detent d, and pushes the latter downward along with its rod. The lever b then lifts the rod V W, and the

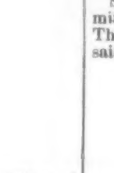
catch X is detached as before from the stop Z. At the same time the ring at the upper part of the rod *a* abuts against the lever O and causes it to descend, thus disengaging the barrel E from the wheel F, and stopping the motion of the screw. By a very simple arrangement, the catch X is made to fall of itself, when the stop Z is lowered. The detent *d*, thrust downward by the wheel R of the descending screw, strikes with the extremity of its upper horizontal arm the appendage of a piece, *e*, which is fixed upon the rod V W, and which rises while the screw is descending. In this way the lower arm of the catch X is repulsed toward the right, and the appendage *d* is disengaged from the ring of the wheel R, so that the catch X acts anew with freedom. Such a moment is represented in Fig. 4. As may be seen, the operation of the machine is effected by raising or lowering the stop Z, above and below the catch X, which falls back every time automatically.

THE TELEPHONE—FROM 1837 TO 1882.*

By Amos Emerson Dolbear, Professor of Physics, Tufts College, Boston.

The Professor said that in the attempt he was about to show them something concerning the development of a new system of telephonic communication, he had thought it best, at the outset, to go hastily over the history of electric telephony. Of course, he knew that the main points in these matters were familiar, more or less, to them all; but he thought, if he devoted a little time to it, it would be refreshing the memory of some of them. Among the earliest attempts which had been made to transmit sound through the agency of electricity, the first that he knew of was that made by Dr. Page, of Salem, Massachusetts, somewhere about the year 1837. Those present would remember his device: It consisted of a bar of iron around which was wound a coil of wire. When a current was passed through this, it gave out a sound; indeed, it gave out a sound every time it was magnetized or demagnetized. The bars were of considerable magnitude, some of them two or three feet in length. The cause of that sound was understood to be molecular disturbance, whereby the bar was lengthened. When these sounds or clicks followed each other with a sufficient rapidity per second, of course we have a continuous sound. The break-piece he employed was an automatic one—an electro-magnetic and contact breaker. The sound he got was sufficiently loud to be heard at a considerable distance. He was not aware that Dr. Page made any attempt to transmit articulate speech. Of course, nothing but a certain definite pitch could be transmitted in that way.

The next attempt was by one they had probably not heard about—it was made by a Mr. Farrar, of Southern New Hampshire. He first proposed to make a kind of electric telephone, in which sounds of different pitch should be transmitted. He, for his device, employed an electro-magnet with a vibrating armature, something like this diagram.



For his transmitter he employed a device consisting of vibrating reeds which could be manipulated by the ordinary keys of a melodeon or piano, opening and closing the circuit like Helmholtz's tuning forks, or like some of the devices employed in quadruplex telegraphy. With this apparatus he was enabled to transmit tunes. After that it occurred to him that it might be possible to transmit speech. He spent some time in experimenting, but did not succeed in making a transmitter. Soon after this Helmholtz employed vibrating tuning forks with electro-magnets.

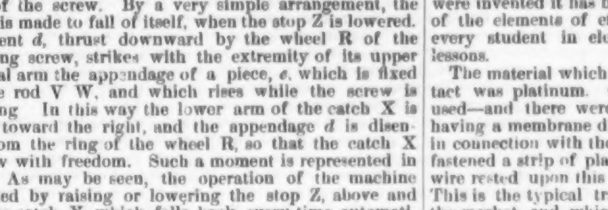
About the year 1860, Philip Reis, of Germany, of whom they had heard so much, undertook, by himself and with extremely meager resources, to solve the problem of transmitting articulate speech. Let them suppose that this problem was to come to them to-day for the first time, they having possession solely of such knowledge of electricity and of the conservation of energy as existed in those days. It was known that a sound of a definite pitch could be reproduced at a distant place. The problem was how to make the vibrations of the human voice bring about the varying conditions in a current of electricity which should reproduce, at a distant place, corresponding sound vibration. Reis knew that a drum-head or diaphragm, when vibrating, must constantly vary the pressure upon it of any body in contact with it, and he employed that device to vary a current of electricity.

It has been denied that it was then a matter of common knowledge that differences of contact pressure made a difference in an electric current, and such knowledge has been proclaimed as a discovery of later days, but since batteries were invented it has been known that proper contact is one of the elements of efficiency for an electric current, and every student in electricity learns this among his first lessons.

The material which Reis employed for his varying contact was platinum. One of the specific devices which he used—and there were several of them—was a cubical box having a membrane diaphragm at the top and a mouthpiece in connection with the inner part. On this membrane was fastened a strip of platinum, and a small piece of platinum wire rested upon this strip, completing the electric circuit. This is the typical transmitter which is usually shown in the market, and which is pointed to when Reis's work is mentioned (a transmitter of this form was exhibited, it being one made by Albert in 1863, Albert being instrument maker for Reis).

Reis, however, did not confine himself to this form, but made several forms, one of which had a shallow chamber, and is represented in diagram No. 1.

So much for Reis's transmitter. For a receiver he adopted, at first, the same receiver which was invented by Page—a straight rod of iron, surrounded by a coil of wire in electric circuit with the transmitter.



No. 1.

This receiving magnet he had mounted on a box for resonant effects. The question was, Would this receiver receive? There is no dispute about that, so far as the principle is concerned. What results did Reis get from that? Evidently very meager—and why? The whole thing was set on a box on a table with the evident expectation that it would make as loud a sound as ordinary telegraph instruments made. But it would not do it, neither will any receiver that has yet been made. In order to utilize the best receivers we have to-day, it is necessary to box them up. But Reis did not stop with that receiver. He made another, which embodied still a different principle.

It seems a remarkable thing that people, when speaking about Reis's transmitters and receivers, refer only to his first instruments, quite ignoring his later ones.

He invented a receiver in which an armature was placed in front of an electro-magnet in order to utilize the magnetic induction to produce the vibratory motion of the armature. (See Diagram 1.) This was used in 1863.

Then let us see what it was that Reis did.

He invented a transmitter which would vary the strength of a current of electricity by the varying degree of pressure which was brought about between the contact surfaces, and, as was before stated, whether or not there was entire break of contact under such conditions, as these depended solely on the amplitude of the vibrations of the diaphragm. It was not necessarily broken at any time when in use. The speaker could testify that the instrument would talk and would talk well. The identical instruments employed by Reis would do that, so that Reis's transmitters would transmit.

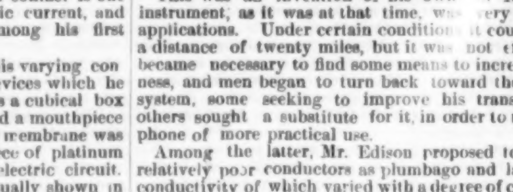
Secondly. His receiver would receive, and Reis did transmit and receive articulate speech with such instruments. There is no doubt about it all. This system, the speaker said, he should call *Reis's system.*

An improvement on that system was soon made, in which permanent magnets were substituted for the electro-magnets and the battery was dispensed with, as illustrated in Diagram No 3.

This was an invention of his own in 1876. But the instrument, as it was at that time, was very limited in its applications. Under certain conditions it could be used for a distance of twenty miles, but it was not efficient, and it became necessary to find some means to increase its usefulness, and men began to turn back toward the original Reis system, some seeking to improve his transmitter, while others sought a substitute for it, in order to make the telephone of more practical use.

Among the latter, Mr. Edison proposed to employ such relatively poor conductors as plumbago and lampblack, the conductivity of which varied with a degree of compactness to which they were subject, as illustrated in the well-known Clerac's tube, and he thus developed what is commonly known as the Edison transmitter.

Prof. Hughes discovered that gas carbon, when in an unconstrained state was as efficient or more efficient than any other substance appropriated to that use, and now when the gas carbon is made to take the place of the platinum in the Reis instrument, we have one of the most efficient transmitters that has yet been invented. He had now, in Diagram No. 4, what represented the identical instrument—invented by Dr. Reis—in all its features except that carbon was used

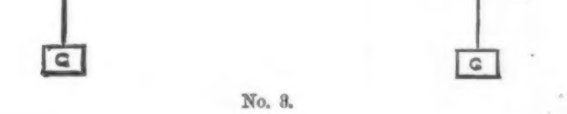


No. 2.

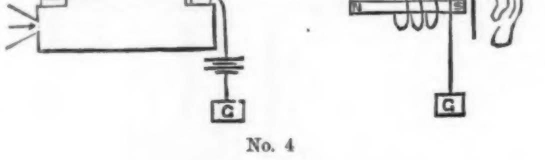
in the place of platinum, and he (the Professor) would say that this instrument was as efficient a transmitter as had ever been invented, and furthermore, it was coupled up with the magneto apparatus, and was what is known as the present Bell system. They would see it was the original Reis system, plus a permanent magnet.

There was another device, which to some would seem the same as the foregoing, but it was worked upon another principle altogether, which might interest them to know more about. (The Professor here had recourse to the blackboard to illustrate the instrument he was alluding to. He here described the Rotaphone, and also described a sounder and a relay which were adapted to telephonic work, all invented by himself. The instruments were exhibited.)

Having described these, he would now come to the particular one he had there to exhibit, and in order to lead up to that, he wanted to remind those who had experimented with so-called static electricity, that any one who has charged a Leyden jar must have noticed that it always emitted a sound. They could always hear it cracking and snapping, and it so continued until it was discharged. This had been known for a long time. The first experiments that he knew of, in which the sonorous effects of condensers in any other form than those of the Leyden jars were observed, were those of Sir William Thomson about 1863, in which he had an air condenser in connection with some submarine cable; and he observed that as often as the condenser was charged or discharged it produced a sound, and the sound appeared, as he thought, to come from the air between the two parts of the condenser. Afterward Dr. Wright coupled up two pieces of silvered paper, back to back, and connected them with terminals on a secondary coil, and that with a Reis transmitter—and he found that by charging and discharging, he could make sounds loud enough to be heard in a hall of considerable size. I have never heard that articulate speech was



No. 3.



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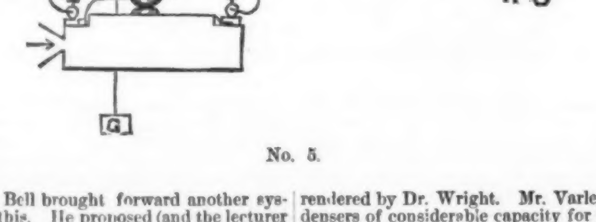


No. 5.

In 1876, Prof. A. G. Bell brought forward another system, quite distinct from this. He proposed (and the lecturer thought he was the first in the world to propose) to speak to the armature of an electro-magnet with the expectation that somebody else listening to the armature of another electro-magnet in the same circuit might be able to hear the spoken words. His device they were all acquainted with. He had made a diagram of this (Diagram No. 2).

Prof. Bell proposed to have in one circuit two similar instruments, each provided with an armature in front of its proper pole, and he expected that words spoken to one armature would be heard by a listener at the other end. But the principle involved in this was different from that of Reis. In this case the two magnets were included in the same circuit with a battery, and any motion of the armature in the one would vary the current on the line. This, he said, was a new system.

rendered by Dr. Wright. Mr. Varley then employed condensers of considerable capacity for producing sound. The speaker was not well acquainted with these devices, but he did not understand that Mr. Varley got articulate speech from his arrangement, or that he attempted it. But although his (the Professor's) apparatus was in some respects similar, it was not true that he worked up to it from that direction. It occurred to him that if he should pass a varying current of electricity through a substance that electricity would decompose, and the decomposition of that substance should result in the liberation of gaseous material which would increase in volume, he would have the means of setting up vibrations. (The Professor then described his apparatus, illustrating it on the blackboard.) This instrument consisted of a plate opposite another one, the space between the two being practically watertight. He supposed that the material he placed between the two would be decomposed.

* A paper read before the Society of Telegraph Engineers, London.

He put on an ear piece, and listened and heard. He found one time, when he was at work at this, that for some reason the liquid had leaked out, and that he was still able to hear when there was nothing but air between the plates. He took the hint and worked out on that line, and developed from such conditions as those the present instrument. This instrument consisted of substantially the same parts as the previous one, excepting that the decomposable material was left out. He wanted to say something about the electrical condition present in this instrument. It had been known for a very long time, perhaps from the earliest days, that an electrified body would attract another body in its neighborhood. (The lecturer illustrated this on the blackboard.) Let them suppose then that here was a wire which came from some source of electricity—here was a body, say a pith-ball. That body would be electrified. This is a case of action at a distance, a physical condition which was extremely interesting for many reasons. There was a great deal involved in that kind of action which they, as physicists, had to look after. If, instead of putting the pith-ball there, he should put a plate; separating the two by means of a non-conductor, the electric pulsations in the one would result in attraction upon the other. In describing this it was said that one was inductively electrified; but the effect was to make the plate move. The strength of this attraction would vary with the kind of material that was employed, with the electromotive force which was acting upon this plate, and also with the shape and physical conditions of it. Suppose they looked for a minute or so at the necessary conditions for getting a maximum amount of sonorous work out of a device of this kind, *i. e.*, a condenser. It must be that the plate was free to move, free to vibrate. Suppose, then, they were using an ordinary condenser, made in the way he would show on the blackboard, in which they had the plates like those in the diagram. Now the electrical condition here would spend itself on them, and they would have, not maximum condition, but the very minimum. These plates must not touch each other if they were to get the best results from them. The vibrations occurred with such great rapidity in articulate speech that it was an essential condition for the maximum amount of work that the plates should not be capable of absorbing to any appreciable extent the electrical conditions. He had worked with plates of all sizes, from those not larger than the end of one's finger to those, perhaps, two feet in diameter.

Now he would say a few words about the different conditions at the transmitting ends. In the four diagrams he had shown, only the essential features had been drawn. In No. 4 he was quite aware that an induction coil was used, but it was not an essential thing. In No. 5, which was his system, it was essential that he should have the electromotive force. If he connected up an instrument of this sort with No. 4, an appreciable result would be got from it, because the electromotive force there is not sufficient. There were two or three ways in which they could use a transmitter. One of them was by means of electric machines. Let them suppose that instead of a battery being the source, it was an electrical machine which would give a jumping spark. He could get a current of electricity in this way which would pass a certain distance in air.

If, however, he took an ordinary induction coil having a sufficient number of turns, he would then have the means of getting the high electromotive force essential for working this instrument. In that case he would have the device shown on the board, in which was a Reis transmitter connected with an induction coil, connected with his receiver. In this case the undulatory current in the primary circuit set up varying electromotive force in the secondary coil to work the instrument. External resistance was a very small factor, indeed. The length of wire through which it would work was almost unlimited.

He would now exhibit the working of these instruments. He had set up several instruments there in working order, which he would show.

Arranged on stands in different parts of the hall were twelve receivers, all connected with a single transmitter, in which was employed a single small bichromate cell. Counting, whistling, and a cornet solo were distinctly heard in all parts of the hall.

He then showed that it was not necessary to have a return circuit, for a receiver was shown which had but a single terminal, and the sounds from this instrument were not inferior in loudness to the two-terminal receiver.

He next said that it was not necessary that there should be even two plates, and he showed an instrument having but a single plate and terminal, to which the president was invited to listen, and he reported that he heard perfectly with it.

And lastly, the Professor said he had discovered that even connection with the line was unnecessary, and he therefore quite disconnected a receiver from the line wire, and handed the instrument to the president, who, at a distance of several feet, reported that he heard perfectly, although the sound was much weakened.

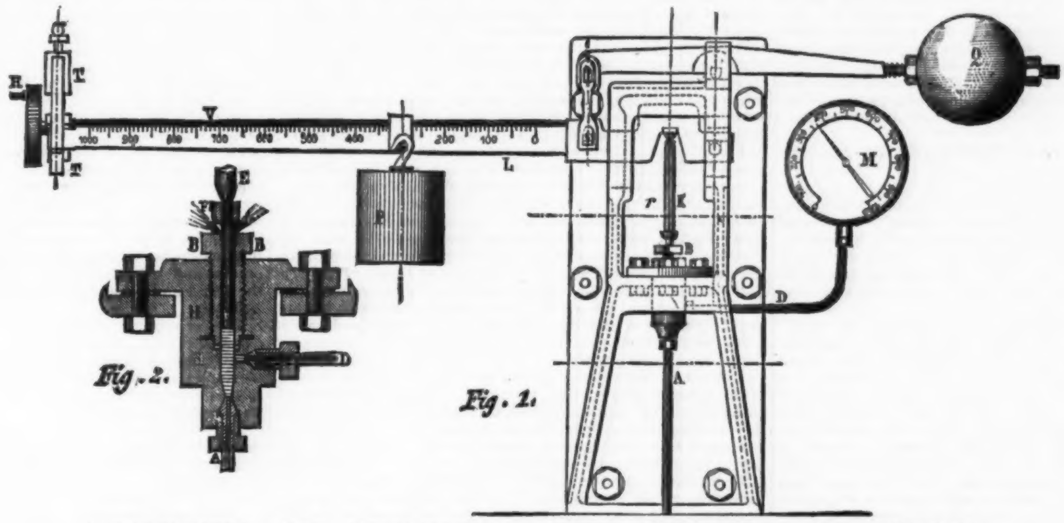
The speaker thought it might be well for him to say a few concluding words (regarding this system which he had just shown them) concerning its advantages, and why he described it as a new system. The Reis system was one in which the electricity was transformed into magnetism, and this into the vibratory motions of the plate. In this system the electric transformation was but a single one, the electricity being transformed immediately into the vibratory motion without the intermediation of magnetism. On account of the electromotive force, the matter of resistance does not enter it as a factor, as in electromagnetism. There, of course, Ohm's law was applicable, but in this case it was not—at any rate within the limits of figures which they were capable of manipulating.

The cost of the apparatus was nothing very great. It was about the same as the other system. As to what it would do, he would simply tell them what he had done with it. He had had a line between his lecture-room and his residence—a line of about half a mile in length—which, for two years, had been worked on this system, and it was going as well then as when he put it up two years ago, and the single cell of battery which had been used had received no attention except to add a little water. He had also used it on tolerably long lines, one of 40 miles, and one, the telegraph line of the Rapid Telegraph Company between Boston and New York, 256 miles in length. This last one he talked over during a storm, expecting a loss from leakage, but he was able to hear very distinctly. As to what it was capable of doing beyond that, he had not had opportunities of trying.

At the conclusion of Professor Dolbear's address, which was received by the audience with marked expressions of approval, the chairman expressed his gratification and appreciation, and called upon Mr. W. H. Preece. The latter gentleman warmly commended the address, and declared his interest in the invention of Professor Dolbear, because of its practical importance to the world, as well as its scientific novelty. It should be the policy of the Government to foster and encourage all such advance in a science so important as telephony, and if the Patent Laws of Great Britain are not such as to secure that result, Mr. Preece remarked that it was time they were altered. He moved the thanks of the society to Professor Dolbear for his valuable paper. Professor Carey Foster seconded the motion in a few well chosen remarks, and the chairman declared the motion unanimously carried.

APPARATUS FOR MEASURING HIGH PRESSURES IN LIQUIDS.

THE apparatus invented by Mr. George Marié for measuring very high pressures in liquids, and the general arrangement of which is shown in Figs. 1 and 2, is based upon the following principle: A very sensitive valve is loaded directly in such a way as to be held in its middle position, above and below which it rises and descends an excessively small distance, so that it is never, properly speaking, closed. The aperture left free by this valve is such that, under a pressure of 200 kilogrammes per square centimeter, the quantity of water that can be disengaged per second is only one cubic centimeter.



APPARATUS FOR MEASURING HIGH PRESSURES IN LIQUIDS.

Fig. 2 shows the valve on an enlarged scale. The piston, C, of the valve is formed of an alloy of 10 per cent. aluminum with 90 per cent copper. This bronze is hard and almost inoxidizible, works well, and may be easily cast. The piston is very carefully turned, as is also the cylinder, B, and is so adjusted as to slide very easily in the latter, and allow the passage of one cubic centimeter of water under a pressure of 200 kilogrammes per square centimeter, which corresponds to 3·2 cubic centimeters for a pressure of 1,000 kilogrammes.

There is screwed to the piston a cross piece, F, which, by two spiral springs, *r*, is suspended from the lever, L. The cylinder, B, is screwed into a solid casting, H, which is affixed to the frame of the apparatus in such a way that it may be adjusted. Into this piece there penetrate the two pipes, A and D, the first of which is connected with the compressor, and the second with a pressure gauge, M. The lever, L, does not act directly upon the valve; but there is an elongated piece, E, interposed between the two, and, as the piston of the valve has a travel of only 0·2 of a millimeter, the latter may be considered as loaded exactly at the center and parallel with its longitudinal axis. The lever, L, is balanced by a counterpoise, Q; and a weight, P, movable by the aid of a screw, V, and winch, R, allow of loads varying from 0 to 1,000 kilogrammes per square centimeter, being made to act. The lever, whose extremities oscillate between two stops, T, which allow it a play of 2 millimeters, is graduated into divisions 1·5 millimeters apart. As soon as the lever strikes against the upper stop, whose position may be exactly adjusted, an alarm is rung.

This apparatus has been in use since November, 1880, and has given very satisfactory results. A very careful calculation of the causes of error of the instrument has revealed the fact that the errors are proportional to the pressure measured, and that their sum is equal to or below 0·0075037, on an average. There is, however, one source of error which cannot be calculated, and that is the friction that possibly results from the contact of the valve with its seat. Besides this, the impurities in the water may lead to inaccuracies. But it has been found that such causes of error are not of much importance, and an endeavor is made to avoid them by making frequent control observations with a very sensitive pressure gauge formed of a Bourdon spring wound spirally, and which transmits its motions directly to a long aluminum needle, without any intervening mechanism. This apparatus, then, presents within itself a minimum of sources of errors. The water may be rendered pure by filtering it.

The apparatus may be applied to a large number of practical and scientific uses, among which may be cited the calibering of pressure gauges, an operation that may be performed with as great a degree of approximation as may be desired by placing in the apparatus, one after another, valves of different diameters. It may be likewise applied in the manufacture of regulating and pressure gauges, and the pressures may vary from 0 to 1,000 kilogrammes per square centimeter.

GELATINO-CHLORIDE OF SILVER PICTURES BY DEVELOPMENT.*

FROM the earliest days of photography chloride of silver has been most largely used in the production of photographs; but hitherto very little has been done in developing the latent image formed by the action of light on chloride of silver films. The idea is not, however, a new one. I have brought for your inspection some fine transparencies developed on collodio chloride by Mr. H. J. Newton, President of the Photographic Section of the American Institute, New York. These beautiful pictures were presented to me in America in the year 1872—just ten years ago. Since that time others have experimented in the same direction. Mr. Herbert B. Berkeley has from time to time published the result of his researches; and more recently Dr. Eder and Captain Pizzighelli have given details of their method of producing diapositives on emulsion plates containing chloride of silver in combination with gelatine. The same gentlemen have also shown at Vienna, and at the recent technical exhibition in this building, a series of beautiful transparencies which were universally admired. As these pictures seem to have awakened considerable interest in the process by which they were produced, I propose (this evening) to demonstrate the method of producing transparencies on gelatino-chloride plates, and to describe certain modifications in the development which I have found to give the best results.

For the preparation of the emulsion the following simple formula is all that is required:

Gelatine	400 grains.
Cold water	4 ounces.
Nitrate of silver	240 grains.
Distilled water	2 ounces.
Chloride of ammonium	100 grains.
Water	4 ounces.

Mix the above in three separate vessels, allow the gelatine to soak for ten minutes, and warm all the solutions to about 120° F. Now add the silver to the gelatine, and immediately afterward add the chloride. Emulsify at the same temperature for about an hour; then allow the emulsion to set. Pass through canvas and wash in running water for some hours in the usual way. When washed and dissolved by gentle heat the emulsion will be ready for coating the plates. The glass chosen should be as thin and flat as possible to insure contact in printing from the negative. The dried film should appear pure white by reflected light, and of an orange tint by transmitted light. The latter color is owing to the chloride of silver being held in an extremely fine state of division.

With regard to the sensitiveness of these plates, I have found them at least a hundred times less sensitive than ordinary gelatino-bromide plates. The time of exposure will depend, to a great extent, upon the color desired in the transparency and the strength of the developer. With a moderately strong developer an exposure of two or three seconds to diffused light under an ordinary negative will give all the detail.

The developer I use is a modification of Dr. Eder's formula, and that of Captain Abney. A stock solution is made as follows:

Citric acid	5 ounces.
Distilled water	20 "
Strong ammonia	2 "

The heat produced by the addition of the ammonia will cause the crystals of citric acid rapidly to dissolve. As soon

* A communication to the South London Photographic Society.

as the mixture is sufficiently cooled the solution is ready and will keep a long time. When required for use, mix three parts of the above solution with one part of the ordinary ferrous oxalate developer freshly made, by adding one part of a saturated solution of sulphate of iron to three parts of a saturated solution of neutral oxalate of potash. Now add to each ounce of the mixture two to three drops of a twenty grain solution of bromide of potassium.

This will form a very powerful developer for the gelatino-chloride plates, and with a moderately short exposure will give a rich purple tone to the transparency. For a pure black tone expose less time, and use equal parts of the ferrous oxalate and citrate of ammonia solutions, with an extra drop or two of restrainer, if required. If much warmer tones are desired, six or eight parts of the citrate solution should be used to one part of the ferrous oxalate. Any shade of color may be obtained, from jet black to bright ruby red; but with the weaker developer it will be necessary to increase the exposure considerably. For instance: to obtain the ruby color two or three times the exposure will be required than for the black tones with the stronger developer. In this way a great variety of beautiful tones may be produced at will; but the great advantage of this method of development consists in the very great latitude allowed in the exposure. When working by daylight and with negatives of different degrees of density it is practically impossible to be sure of getting the correct exposure except by repeated trials, unless the developer can be regulated to suit the exposure given. By my method this is easily done. I make three or more portions of developer of different degrees of energy; that is, containing a greater or less proportion of the ferrous oxalate. Should the transparency appear under-exposed the developer is at once poured off and the development completed, and all the details brought out with a more energetic solution. In the case of over-exposure the operations are reversed. This power of correcting under or over exposure in the development of pictures on chloride of silver has not hitherto been obtained by any known method; and I think I may venture to assert that, without the power of compensating for errors in exposure, the process of printing by development on chloride of silver, however beautiful in some of its results, would be practically useless. With regard to the keeping qualities of the developer, I find that after being mixed it gradually but slowly loses its energy, otherwise keeping in perfect condition for several weeks. It can, however, at any time be restored to any desired strength by adding the proper proportion of freshly made ferrous oxalate developer, as in the first instance.

With regard to the utility of this really beautiful process, I think few will question its superiority for the production of the most exquisite transparencies for lantern slides, or for making enlarged negatives. There is, however, another application of the process which may eventually prove of far greater importance; I allude to the rapid production of silver prints on paper by development, instead of the present slow process of printing out under the negative. I have already made a few experiments in this direction, and from the results I have already obtained I should judge that it is not improbable that the process I have described to you to-night will prove in time the quick printing process of the future.

B. J. EDWARDS.

ON CRYSTALLIZED ANHYDROUS GRAPE-SUGAR.

By ARNO BEHR, Ph.D.

ANHYDROUS grape-sugar in a state of purity has so far only been obtained from an alcoholic solution. Two years ago F. Soxhlet found that the best solvent for it is methylic alcohol, from which much larger and better developed crystals can be obtained than from the solution in ethylic alcohol. I have found that it can even more easily be prepared from a watery solution.

The principle that a crystal introduced into the supersaturated solution of the same substance induces crystallization, has long been applied to the practice of grape-sugar manufacture. In order to hasten the hardening of the sugar, a certain quantity of the already hardened sugar of a previous operation is stirred into a mass. But as the ordinary commercial grape-sugar always contains the hydrate, the crystallization so obtained is also that of the hydrate. I put the question to myself, What would happen if, instead of the hydrate, I introduced the crystallized anhydrous sugar into a concentrated solution of ordinary grape-sugar. I tried the experiment, and must confess that I had not much hope that anything else but crystallized hydrate would be the result, for I expected to see the anhydride transformed into the hydrate within the watery solution. I was agreeably surprised when, on the next morning, I found the glass filled with a neat crystallization of anhydrous grape-sugar, from which the liquid part could be easily drained. The few crystals of anhydride, far from being transformed into the hydrate, had induced an ample crystallization of their kind. The explanation of this fact is found in the following: In its crystalline form anhydrous grape-sugar is not deliquescent, even in very moist weather, and it is stable in comparatively dilute solutions of grape-sugar. I have kept crystals exposed to the atmosphere of the laboratory for months, and during moist weather, without seeing them lose their sharp outlines and bright appearance, and I have repeatedly found the sirup drained from a crystallization of anhydrous sugar to contain as much as 26 per cent. of water. The limits of concentration, within which this crystallization can be obtained, are rather wide; but in order to secure a good result, the solution ought to contain from 12 to 15 per cent. of water. It is well not to allow the mass to cool rapidly, or the temperature to fall much below 30° C.; for at a lower temperature, and before the remaining sirup has been diluted by the separation of the anhydrous crystals, concentrated solutions are rather viscous, and this viscosity prevents a free crystallization. A good temperature is 30° to 40° C. The time within which the crystallization is completed varies between half a day and several weeks, according to the purity of the mass.

Though it is always well, in order to secure a uniform and speedy crystallization, to start it by the introduction of some crystals, yet it is possible, and, for sugars of high purity, quite easy, to obtain the same crystallization by simply keeping the concentrated solutions at a temperature of about 30° C. for some time. Under these circumstances, a crystallization of anhydrous grape-sugar takes place. This behavior of grape-sugar is also unexpected. Soxhlet, who, a short time ago, took out patents in different countries for the refining of grape-sugar by means of alcoholic liquids, and for the production of a hard crystallized grape-sugar, describes one of his products expressly as the hydrate of the formula, $C_6H_{12}O_6+H_2O$; yet he concentrates highly a solution of very pure grape-sugar, and allows it to crystallize at an elevated temperature. I have failed, under the conditions of my experiments, to obtain the hydrate, but that it is possible for the hydrate to crystallize in large and well-developed crystals has been established in 1877 by Halse and Steiner, who analyzed a crystallized hydrate of grape-sugar, of which some crystals weighed 4 to 5 grms., and which was readily taken for cane-sugar. This grape-sugar had made the voyage from England to Australia and back, and during this time had undergone the transformation.

A product which has for some time played an important part in the literature of this subject, is Anthon's hard crystallized grape-sugar. As early as 1857, Anthon, in Prague, prepared a very pure sugar by crystallizing and pressing the hydrate. He then melted the press cakes without addition of water, and allowed the mass to solidify in moulds. He obtained crystalline masses, which, according to his analysis, contained 4·7 per cent. of water, and for which he claimed the constitution of a half hydrate of grape-sugar of the formula $2(C_6H_{12}O_6)+H_2O$. As he did not drain his crystals, he certainly had nothing but a mixture of anhydrous sugar and the hydrate, the surplus water of the hydrate having been evaporated during the melting. This has already been suggested by Stohmann in the latest German edition of "Muspratt's Chemistry" (vi., 2,077).

Crystallized anhydrous grape-sugar, such as I have prepared from a watery solution, has the following properties: Dried at 30° to 40° C., it does not retain more than 0·2 per cent. of moisture, the moisture determination being made at 130° C. It shows a neutral reaction with sensitive litmus paper. It melts in a capillary tube between 141° and 145° C. It was tested in the polariscope, and showed bi-rotation. Landolt, in his book on the optical rotatory power of organic substances ("Braunschweig," 1879, p. 184), gives 32·68 grms. as the amount of pure grape-sugar, which, taken instead of the normal weight of cane-sugar, should show 100 on the scale of a Ventzke-Soleil instrument. It was found that, if this amount was rapidly dissolved in cold water and immediately polarized, it showed a polarization varying between 202 and 204; if it was allowed to stand for twenty-four hours, 101 to 102. This difference is mainly due to an error in Landolt's figure. This figure is calculated from an assumed specific rotation of $\alpha_D=53·0$. This is correct only for a concentration of 10 grms. of sugar in 100 c.m. of solution; but for a concentration of 32·68 grms. in 100 c.m., α_D becomes $=53·57$, according to Tollens's determinations. Therefore, 32·68 grms. ought to polarize 101·1, while the observed polarization for mono-rotation was 101 to 102.

These are the facts so far as they refer to chemistry; but in view of the increasing importance of grape-sugar as an article of general consumption, I wish to add a few remarks with reference to the industrial application of these observations.

In the ordinary process of the manufacture of grape-sugar from starch, the conditions are such that the resulting product is always far from being pure grape-sugar, however pure the starch from which it was derived may have been. Though a good method for the quantitative determination of starch consists in its conversion with a mineral acid and subsequent determination with Fehling's solution, yet in practice a smooth and complete conversion is not attainable. The reason for this difference lies in the fact that the chemist, for a complete conversion, works with a very diluted solution, while the manufacturer necessarily works with solutions of higher density. At a higher density, however, the acid seems to act on the sugar already formed, and before all the dextrin is converted into sugar, the sugar itself is partially converted into something else, which constitutes an impurity of the final product. So far, we know very little about the nature of these impurities of commercial grape-sugar, but several chemists have asserted that the residues which remain after fermentation and distillation are more or less injurious to the human system. This subject, though, requires a more complete investigation. As the principal use of all the grape-sugar produced is that which is made of it in the manufacture of fermented beverages, beer and wine, it is easy to understand the rising demand for a purer article.

F. Anthon has, twenty years ago, called attention to the disadvantages arising from the use of impure grape-sugar in wine making, and suggested a remedy. His suggestion was to refine the ordinary grape-sugar by crystallization, and the use of a centrifugal machine for the removal of the liquid impurities. He modified this process in so far as he used a strong press instead of a centrifugal machine, and, according to the testimony of several chemists, really produced an article of remarkable purity. His process seems to have never been used for any length of time on an extensive scale.

Fouchard had already, in 1853, manufactured a refined grape-sugar by allowing grape-sugar solutions to crystallize in barrels, and then withdrawing the liquid portion through a number of holes in the bottoms of the barrels.

Though the principle of these refining processes is correct, yet there is a difficulty inherent in it, which arises from the form and nature of the crystals in which the sugar solidifies. Under ordinary circumstances, grape-sugar crystallizes from a watery solution as the hydrate in the shape of very fine tablets, which are mostly grouped spherically. Owing to the fineness of the tablets and the capillary attraction, it is difficult to remove the impure mother-liquor sufficiently from the crystals by means of a centrifugal machine, and even with a hydraulic press high purity cannot be obtained together with a large yield. It is different with the crystals of anhydrous grape sugar. They are of a prismatic shape, and form loose aggregations, from which the sirup can be easily removed by centrifugal force, and which lend themselves to a treatment of draining and washing very similar to that of cane-sugar. Under these circumstances it is possible to produce a grape-sugar which compares in purity with block and granulated cane sugar. A number of applications for such an article readily suggest themselves. The confectioner, the druggist, the manufacturer of condensed milk may use it. In the preparation of certain wines it can safely take the place of cane-sugar, but its principal use ought to be in the kitchen for all those preparations where utmost sweetness is not sought for. It is not so well suited for tea or coffee, though it does not quite so unfavorably compare with cane-sugar, as the books will have it. To obtain a moderate sweetness, equal to that produced by a given amount of cane-sugar, it is not necessary to take two and a half or three times as much as cane-sugar, but only about one and two thirds times the quantity; at least I have found it so, and so have some of my friends.—*Chem. News.*

ALLEGED SACCHARIFICATION OF STARCH BY WATER UNDER HIGH PRESSURE.—The proportion of sugar formed is greater the less water acts upon one part of starch. It was found that the presence of a trace of free acid, as met with in the potato and the wheat starches of commerce, is necessary. If this acid is removed no sugar is generated.—*Prof. F. Sohxlet.*

ALBUMINATED FERROUS BOROTARTRATE.

By CARLO PAVESI.

IN the January number of the *Annali di Chimica* of Milan, Carlo Pavesi gives the following process for preparing the above salt, which is stated not only to possess sedative properties, but to act also as an antiseptic and antifermentative. According to the author its chemical composition is that of an albuminated borotartrate of protoxide of iron.

Pure and fine iron filings	2	parts.
Boric acid in fine powder	1	"
Tartaric acid in fine powder	1	"
Fresh egg albumen	6	"
Common water	q. s.	

Throw the two acids into a suitable porcelain capsule and then the iron filings, adding sufficient water to convert the whole into a liquid. The mixture is heated to a temperature which gradually increases from 176° F. to 212° F., at which point the capsule is taken off the fire and the mixture is allowed to cool. The albumen is then added and the whole well mixed until it is reduced to a homogeneous mass. It is then set aside for a week in a place where the temperature does not exceed 76° F., the mixture being stirred from time to time so as to insure the chemical combination of the tartaric and boric acids and the albumen. At the end of this time the mixture is filtered through bibulous paper, more water being added if necessary to render the filtration less difficult. The liquor thus obtained is then submitted to a heat that must not exceed 95° F., for fear of coagulating the albumen. The solution being evaporated to dryness the residue is finely powdered and kept in well stoppered bottles.

The principal characteristics of albuminated ferrous borotartrate are described as follows: It forms a light straw-colored powder of a not disagreeable taste, which does not possess the styptic flavor of so many other preparations of iron; it is inodorous and soluble in water; treated with liquor ammoniæ or with potash or soda no decomposition takes place and no precipitate is thrown down, an important property which merits the attention of prescribers. With tannic acid and potassium sulphide it gives a black precipitate and with potassium cyanide a blue precipitate, while the addition of strong acids separates the boric acid and the albumen.

It is claimed by the author that the ferrous borotartrate being in union with the albumen of this compound will, when it is introduced into the system, be speedily absorbed by the mucous membrane of the stomach and carried into the blood without being previously decomposed, and that finding itself in contact with the sodium albuminate contained in the blood, a new salt of soda and albuminate of iron will be produced which is the true basis of the blood.

The author observes that the two acids, boric and tartaric, being well united by the aid of the water, form soluble borotartaric acid, which, coming into contact with the finely divided iron and albumen, produces a salt with a duplicated acid. This salt, he considers, as possessing the important therapeutical properties of its components, and having a taste that is far from disagreeable, ought, when opportunely administered, to be of the greatest service in clinical medicine.

Dr. Cazzatino, of Naples, has experimented in potassic ferrotartrate for external use, especially in the cases of ulcers with a retrogressive tendency, as well as phagedenic, atonic, gangrenous, and syphilitic sores. Dr. Cazzatino has obtained very decided results in such cases, for which reason he hopes to obtain similar results with the albuminated borotartrate of the sesquioxide of iron in cancerous and other ulcers, by soothing the pain, disinfecting the sores, and promoting granulation and ultimate cicatrization.

The ferrous borotartrate united with albumen is said to constitute a salt with a double acid, having an action *sui generis*, which when introduced into the system by the stomach does not disagree with persons even of the most delicate constitution, besides being soluble in water without undergoing decomposition.

The author concludes by recommending the salts of manganese to be used in conjunction with those of iron in cases of anæmia and other disorders where martial preparations are indicated.

CAMPHORATED CHLORIDE OF CALCIUM.*

By CARLO PAVESI.

WITH the view of investigating the results obtained from the application of antiseptic substances to the cure of infectious diseases, the author has, at different times, undertaken various researches into the properties of aromatic, antiseptic, and disinfecting substances. His attention was hence attracted in a special way to camphor and chloride of calcium, chloride of calcium being chosen as possessing all the antiseptic properties of chlorine, while it is not only not deleterious but is of easy application.

The author describes the properties, the mode of preparation, as well as the various applications of a compound which he has obtained by mixing chloride of calcium with camphor in certain proportions and under particular conditions, and which he considers to possess valuable properties that ought no longer to be neglected, either by physicians or pharmacists.

The compound, which he has called "camphorated chloride of calcium," is easily prepared. The following process will be found the quickest and most economical:

Chloride of calcium	50	parts.
Powdered camphor	5	"
Alcohol	25	"
Common water	150	"

The camphor is dissolved in the alcohol in a glass flask, and the chloride of calcium and water added to it. The ingredients must be thoroughly mixed, by allowing the mixture to stand for several days, during which time it must be well shaken every now and then. This having been done the preparation must be filtered through bibulous paper. To the residue remaining in the filter a small quantity of dilute alcohol should be added so as to dissolve as much as possible out of the mixture.

Thus prepared camphorated chloride of calcium forms a limpid liquid, the odor of which recalls those of chloride of calcium and camphor. The liquid will not bear dilution with water, which throws down the camphor as a flocculent precipitate.

The solution added to milk coagulates it immediately, the curd formed keeping perfectly sweet for a length of time.

* Abstract of a paper in the *Annali di Chimica* for January.—*Pharm. Jour.*

It also coagulates both egg and blood albumen, and preserves the coagulum thus formed from decomposition for a lengthened period. Meat immersed in it is also preserved from decomposition. It turns blue litmus paper red and iodized starch paper blue, as well as paper soaked in tincture of guaiacum; the latter possibly from the development of ozone.

Placed in contact with wounds it is said to act as an antiseptic, and to seem destined to render important services in this direction also as a hæmostatic. Cotton wool, tow, compresses, bandages, etc., soaked in it and applied to syphilitic ulcers, open wounds, cancerous sores which have been suppurating for a long time, are immediately efficacious; in fact the author considers it applicable in all cases where the Listerian mode of treatment is adopted, and that it ought eventually to replace carbolic acid for this purpose, seeing that it does not give off any disagreeable smell, the odor of camphor being to most persons a pleasant one, besides which it has the still greater advantage of being neither a poison nor an irritant.

THE ACTION OF SULPHURETED HYDROGEN UPON COMPOUNDS CONTAINING OXIDE OF IRON.*

By J. CARTER BELL.

As is well known hydrated oxide of iron and other compounds of iron are largely used in gas works for absorbing sulphureted hydrogen; but the way in which the gas combines with the iron may vary in each case. Some oxides, though poor in iron, readily take up the gas, while others containing a large percentage of iron, owing to their physical characters, decompose the gas but slowly. I have had to examine many examples of oxide of iron, which were intended to be used for absorbing sulphureted hydrogen, and my practice has been to pass the gas through a tube containing the oxide of iron many times, allowing the sulphide of iron which has been formed in the tube to oxidize after each passage of the gas, and at certain periods to estimate the percentage of sulphur. Great care must be used when the sulphide of iron is undergoing oxidation, the temperature may rise so high as to ignite the sulphur. The following experiment will prove this: Some oxide of iron was prepared and dried at 212° F., this was put into a tube and dry sulphureted hydrogen was passed through; on the passage of the gas the oxide in the tube became very hot; when the contents of the tube were quite black, the tube was emptied, and the sulphide of iron allowed to oxidize; a portion was now used for the estimation of the sulphur, the oxide was put back into the tube, and the gas passed a second time; again it was turned out; this time the action was so intense that the sulphur ignited. The experiment was continued up to the fifth time, estimating the sulphur after each passage of the gas.

After passing the gas once, the percentage of sulphur was	12·28
Second time, the sulphur ignited	0·16
Third time	6·20
Fourth time	8·68
Fifth time	16·60

Two samples were taken. No. 1 was a Lincolnshire iron ore containing about 35 per cent. of metallic iron. No. 2 was a slag from an iron foundry containing about 55 per cent. of iron. Sulphureted hydrogen was passed through these over one hundred times, with the following results.

	Percentage of Sulphur. 1	2
After passing H_2S 10 times	33·671	24·926
" " 20 "	38·521	34·762
" " 30 "	41·729	37·891
" " 40 "	43 916	42·918
" " 50 "	46 512	43·769
" " 70 "	55·321	54·261
" " 90 "	60·122	60·571
" " 110 "	63·816	65·789
" " 140 "	—	71·564
" " 160 "	—	74·612

Mr. Heisch said they were all perfectly aware of the great difference in the absorptive powers of samples of iron of sulphureted hydrogen; some samples sent to gas works were of no use at all, and very few of them in practice reached 74 per cent.

Dr. Dupré asked if the president was acquainted with any instance where a mixture of sulphur and iron actually took fire on exposure to the air—the sulphur being in a fine state of division.

Mr. Heisch said that after it had been exposed to the air once or twice, a large amount of free sulphur was obtained, and this free sulphur became fired if they oxidized too quickly.

Mr. Wigner said a shower of rain was quite sufficient to fire a charge brought out from a purifier.

Mr. Lyte said he had seen it spontaneously fire.

SEPARATION OF ETHER.

By C. J. H. WARDEN.

IN separating quinine and amorphous alkaloids from the mixed cinchona alkaloids by agitation with ether, the subsequent removal of the ethereal layer from undissolved alkaloid and from the aqueous stratum is an operation of some little difficulty. If the ether be decanted off, or taken up by a pipette, small quantities of solid matter, as well as watery fluid, are also likely to be removed, while the ordinary separating funnels do not facilitate the operation. To obviate these difficulties the following apparatus was devised: The apparatus is essentially a filtering siphon, and consists of a siphon shaped tube of thick glass, of small bore, on the shorter limb of which a small funnel has been blown, which is provided with a narrow projecting lip, and with a ground flat rim, while the other end of the larger limb is drawn out. The shorter limb is mounted on a cork, in which there is a second aperture, which carries a small bent tube. The cork fits the bottle in which the operation of agitation with ether has been conducted, and which should be long and narrow. To use the apparatus, the funnel is lightly stuffed with a few fragments of cotton wool, and a piece of filter paper tied over the mouth, the flange preventing it from slipping, and the superfluous paper is cut off short. The funnel is then introduced a short distance below the surface of the ether, and the cork fixed. The apparatus has now somewhat the appearance of a wash-bottle, save that the tube from which the liquid escapes is three or four times the length of the tube which is immersed in the liquid. On gently blowing through the open end of the small tube—which may conveniently have a piece of India-rubber tubing attached—the ether is forced through the filter and fills both limbs of the siphon, and then continues to flow automatically into a reservoir placed for its reception. As the ethereal stratum diminishes, the tube carrying the funnel is depressed until its flat surface is within a line or so from the surface of the aqueous layer, and is engaged in the precipitate. When this occurs, air has again to be blown through the small tube, and this is continued until drops of ether escape only at long intervals. The cork carrying the tubes is then removed, fresh ether poured into the bottle, agitated, and the series of operations described above again performed; and this may have to be repeated a third time. When it is judged the precipitate has been exhausted of principles soluble in ether, the siphon is removed, and any particles adherent to the base or sides of the funnel brushed off, and the funnel, with its attached filter paper, as well as the exit end of the siphon, washed with a small quantity of ether or alcohol. Obviously the apparatus may be used for all operations in which ether, etc., is used for the separation of alkaloids or fatty principles. By having a third aperture in the cork, and fitting into it the delivery tube of a burette, the apparatus could be employed in certain volumetrical analyses. Under such circumstances the tube carrying the funnel should be depressed until the mouth of the funnel is almost in contact with the bottom of the bottle, and the necessary agitation of the fluid, after addition of the precipitant, would then be effected by drawing air through it by the small bent tube.—*Journal of the Society of Chemical Industry.*

* Read before the Society of Public Analysts on 26th April, 1882.

SICK HEADACHE.

By T. CURTIS SMITH, M.D., of Aurora, Ind.

FEW affections are met with more frequently. Few are less amenable to treatment by a careless prescriber. Few cases but can be more or less completely relieved, if the remote and immediate causes of attacks are well searched out and assiduous efforts are made for their removal. One great obstacle in the treatment of this affection, with which we so often meet, is the inefficient efforts our patients make in seconding our advice regarding prophylactic treatment. Every one who has been a close observer of these migrainous patients must have noted that preventive measures, skillfully directed and diligently carried out, will forestall many a fierce assault of the affection, will break the force of the onset, or even entirely prevent any painful suffering. Continued and watchful prophylactic management will, in time, so far remove the disease as to render the attacks light and far between in very many cases. Such continued efforts will be far more likely to be crowned with success where the element of heredity does not too strongly enter the case, than in those where such constitutional tendency already exists. That migrainous attacks may be acquired by any habit, labor, or exposure that, by continued wear and attrition, breaks down the stamina of the bodily powers, is too evident a clinical fact to need more than simple mention here. Time and again have patients come under my care who had been soldiers in the late war, and who protested that prior to the toils, marches, contests, exposures, and privations incident to active military campaigning, they were free from all forms of headache. We meet often with men worn out with their labors in civil life, who, in consequence of nervous breakdown, become afflicted with frequent attacks of sick headache. In other words, the overworn nervous system expresses its undue strain by a storm of head pain with concomitant nausea, vomiting, malaise, etc. Again, we more frequently see this disease in over-worked, over-nursed, extra fashionable, or dyspeptic women, and too often in those troubled with some form of uterine disease or functional menstrual trouble. Indeed, the subjects of migraine, to their sorrow, often find that any and everything that disturbs digestion produces slight constipation, or disturbance of the function of any leading organ, or that a little unusual exposure, irregularity of securing meals, loss of sleep, any sudden strain, over effort, or excitement is sure to find a most painfully unhappy expression in a more or less prolonged and furious assault of sick headache. One who is especially subject to such attacks lives in constant dread of such a storm of wretched nervous expression.

I am well acquainted with and have often prescribed for a typical case of this migrainous affliction. He is aged 40 years, of naturally good physique, of good habits, formerly a great smoker, but has ceased from that years ago; never intemperate, always a hard laborer in his early years, and a hard student after the age of twenty; the latter often concurrent with hard manual labor. He entered military service at twenty-two, where he attained the rank of major in less than two years, and by continued exposure, over marchings, hard-fought contests, privations, etc., coupled with a mind ever weary and restless in his efforts to reach a higher position as well as to thwart and defeat the enemy, managed to see the close of the war with a broken constitution, bringing home a body weighing about 115 pounds, that had weighed 142, and with it a legacy of chronic diarrhea, dyspepsia, and occasional severe attacks of headache, not especially accompanied with nausea, but with great nervous prostration. Soon some of these troubles, as the diarrhea and dyspepsia, disappeared, and, in a measure, the cephalic pains; but he never reached his former weight and generally averaged twenty pounds less. Hard study and continuous labor in his line of business was sufficient to bring on, at quite regular intervals, sharp migrainous attacks. But for these he never left off from his work until after enduring them for fifteen years. Then they came with such a furious storm, and so oft repeated, as to tell on his strength severely and send him often to bed to watch out a night, or days and nights, of most wretched agony. By this time two hours of severe, continued mental effort would prove to be a certain provoking cause for an assault of the pain. Also any considerable bodily fatigue, unusual excitement, loss of sleep, the too long deference of a meal, even the absence of his usual coffee or tea at meal-times, the eating of an apple or ever so small a lunch between meals, the slightest unusual heat or chill, cold or damp feet, exposure to slight rain; in short, the very slightest event unusual to him, and which a healthy man would not notice, was the unfailing precursor of a migrainous assault of sharp severity. I have known quite a large number of such unfortunate subjects, among both male and female patients. I have given the above case the more fully because it is really a typical case, and many a one who reads it, if greatly subject to sick headache, will behold their own likeness in it. But a few days since a patient called on me with whom I had never before met. He proved to be the exact counterpart of the case above referred to. Another, a lady, whose symptomatic history in all points was similar to these cases, so far as it was possible for one of her sex to be so. No doubt every one of considerable experience has met with and noted such cases, and could multiply them many times over.

It is not my purpose in this paper to enter into the pathology of this affection, as I may do at some future time, but simply to enter its field of symptomatology and treatment, and especially to call attention to *one symptom* that has never been named in connection with it, as far as I know. This symptom, while not of vast importance, goes to help make up a case, and to show, if need be, more clearly the neurotic reflex character of the whole storm of migrainous pain.

Symptoms.—A person who is subject to often repeated attacks of sick headache is generally able to say, one, two, or more days before the storm of suffering bursts upon him in sharp cephalic pain and neurotic nausea, that he is threatened with such an assault. The prodromic symptoms are quite clear and numerous; not always the same in the same person, and certainly not always the same in different subjects. We may not be able to name every prodromic or other manifestation. Certainly every symptom named will not attach to every case that comes under our notice.

Among the first symptoms of an approaching attack in many cases will be a feeling of very marked exhilaration, very like that produced by an excessive indulgence in strong coffee or tea. With some, this exaltation affects only the nervous system, without in any marked degree affecting cerebration. This symptom, when present, is always one, but more frequently two days, in advance of the gathering storm. It is like the mariner's calm, when not a ripple disturbs the placid surface of the wide spreading waters. It is "the calm before the coming storm," always auguring a mighty agitation of the on-coming raging elements.

Accompanying this symptom, or following closely upon its heels, is often a markedly craving appetite that will not be appeased by any ordinary meal. If this is allowed its full run, to satisfy it will always precipitate the attack and add to its fierceness. Especially is this so if supper is the excessive meal. Soon after such an indulgence a feeling of general lassitude, physical and mental, comes over the person. The stomach that but a short time before opened its mouth so wide to take in food, and like the grave would never cry "enough," is now weighed down with its load. It can neither throw it off nor readily digest it. The feeling of excessive fullness becomes more distressing, twinges of pain now begin to course through the temporal and frontal regions, the muscles of the nape are sore to pressure, and the weight of the garments fitting there produces a sensation as of great weight, which causes the subject to repeatedly raise and throw back his head or push back his collar, as if to lift it away. There is also marked tenderness on making pressure on the lower cervical and upper dorsal vertebra, especially the seventh cervical and first dorsal. There is a heavy, dull, occipital pain, reflected forward to the sides or crown of the head. Very often there is from the very first a spot on the very crown of the head, as large or larger than a silver dollar, that feels as though a light weight was sitting there all the time, and when the patient's or physician's hand is placed and held there a little while, it seems to be warmer than the surrounding surface. The thermometer will often indicate that the sensation is not without an increase of heat above that of the surrounding area. Sometimes this spot is the central seat of all the severe suffering; a real clavus sensation. Many of these latter symptoms, and more yet to be named, point clearly to the fact that the cilio-spinal center is profoundly involved in the pathology of this affection, and that the terminal twigs of the superior division of the trigeminal nerve are the ones, above all others, that will manifest their painful activity in the fierce explosion about to take place.

Returning again to prodromic symptoms, we desire to note that many, perhaps a majority, of these cases have an entirely different prodromal symptomatic history. The subject may to day be as well as ever in life. But when he goes to bed he has a marked sensation of hunger. If posted as to its meaning he will carefully abstain from the slightest indulgence in food. This sensation is very often caused, not by real hunger, but by real indigestion. If the seeming hunger induces the person to eat at that hour, he will most likely pass a restless, dreamy night, and on rising, often long before rising, he will note a headache already set in, and the usual chylopoetic manifestations already giving expression to their morbid state. If he is careful not to eat, but go quietly to bed, get as good a night's sleep as possible, he may miss the threatened attack entirely. But he is more likely to be less fortunate. He will probably rise in the morning feeling as though his stomach was already loaded with very partially digested food; or it may be already sour, and there may be some nausea. If now he is careful to eat very little or really no breakfast, or best of all, drink only a teacupful of hot, well-salted water gruel, and then go about his business, taking care not to overdo nor over-eat during that day, he may, and most likely will, miss the attack for that time. But if he should be led to eat a hearty breakfast, I can insure him that he will not eat much supper the following evening, and very likely sleep but little during the night. This condition of threatening may last over two or three days, notwithstanding the most rigid care. But so surely as any indulgence looking at all to satisfy appetite is allowed, just so surely will the storm burst forth in all its fury. If the subject of migraine has the nerve and patience to persevere in abstinence from more than very small meals, of very light and very digestible food, until an almost uncontrollable hunger comes on, and with it a feeling that if this hunger is not in some measure appeased the headache will surely and certainly come on; he may then eat a very *moderately* full meal, with the assurance that he will at once be relieved thoroughly. He can then go on with his diet and labors as in ordinary health. But if, even now, when this demanding hunger is upon him, he gives full and unbridled license to his appetite, he will very surely suffer the penalty by a more or less fierce paroxysm of migraine, that will likely be quite long continued. If such a person, feeling the hunger before named, at or about bed time take the precaution to swallow a pretty full dose of pepsin in some acid solution, and then will carefully guard his appetite the next day, he will quite surely escape his enemy.

Again, another class of these migrainous subjects pass through an entirely different routine of prodromal manifestations. They may have a day of happy exhilaration, but are more apt to have one in which light not ordinarily too bright has all at once become painful to the eyes, or surrounding noises not commonly noticed have suddenly become exceedingly annoying and tormenting. Little occurrences that ordinarily produce no chafing now grate harshly on the feelings. A spiteful reply to a best friend may now be heard when the custom has been that of gentleness or even of affection. Again, there are dull, moody feelings, ill forebodings; friendly acts are misconstrued, slights are

conceived where no such thing was dreamed of by the person supposed to render it. Best friends are suspected of having turned a cold shoulder. Business, however prosperous, somehow does not move smoothly. Such persons are sometimes the subjects of visionary phenomena of an interesting and somewhat singular character. Dark spots float in the air. Sometimes many circular stars of rainbow hues float, at seemingly vast distances, before the eyes, always moving so as to keep in the field of vision, and often having a rotary motion among themselves. Others may have pass before their eyes, whether shut or open—more likely when shut—beautiful panoramic views, in which variegated colors and beautiful and fantastic figures may pass in rapid succession. The subjects of migraine always know the meaning of all this morbid visual phenomena, and can have a little time to prepare for the oncoming storm, for when these manifestations have been noted, a very severe and agonizing paroxysm may be almost unfailingly looked for within a few hours. In some cases these optical illusions are not manifested until the severe suffering is fairly on.

The sense of hearing may also be the seat of perversions, but such cases have very rarely come under my notice, and I am not prepared to state their character from any personal observation.

Besides the divisions of cases above referred to, there is yet another, where the person obnoxious to these attacks may rise in the morning feeling as well as usual. He eats and drinks and feels well. But he has a trip to make to some distant point, by rail, or by buggy or coach. Before night he is roaring with sick headache, with no known cause for it only that he has changed his usual routine of living for the day. I am well acquainted with a lady who when she came under my care could not even go to a near neighbor's on a visit, or to a church near by, without being made the subject of the most tormenting attack of sick headache, lasting sometimes two or three days. In some women the menstrual epoch is always ushered in and accompanied with most fearful head pain.

In many subjects a day of constipation is sure to be followed by an attack. Constipation in many is the sure and sole cause of the whole trouble, and can always be relieved by securing moderate or free catharsis. Biliousness is a common precedent. So also is lithuria, or the inactive condition of the renal organs. That these organs become sluggish and fail in the free performance of their functions primarily, and thus give rise to the migraine, I do not in any wise believe. On the contrary, I am reasonably sure that all the chylopoetic symptoms are the result of disturbed nerve power, or of a neurasthenic condition of the nerve centers, which themselves have been weakened or unfavorably impressed by some indiscretion in the manner of living, or in over taxation of physical or mental powers.

I will now refer to a rather unsavory symptom that I have never seen mentioned by any writer, nor heard referred to in any way by any person. This, like those already given, is also premonitory, and very often constitutes the first and most persistent outpost of alarm, never letting up until the force of the attack is past and amelioration is declared. How shall I describe it so there may be no mistake? I will speak plainly, then I shall not be misunderstood. Every one has now and then felt the more or less pressing necessity of visiting the water closet to evacuate the bowels, and yet, from force of the situation, could not for a while respond to this call of nature. In order to restrain the evacuation for a time he must needs bring his volition to bear strongly upon the sphincter ani, and if hardly pressed, will also call into action the levator ani muscle, and there retain the muscles in tonic contraction until such time as he may relieve himself. Well, the symptom I refer to now produces just the sensation, or quite nearly that which is felt by any one who feels the necessity of going to stool and yet must needs wait a while—cannot go just then. In other words, there is a firm, tonic contraction of the sphincter ani fibers, and also of the levator ani muscle. This morbid manifestation is very often among the very first to give warning of the on-coming storm of sick headache. It is also one of the most persistent of the symptoms, for it lasts from the very first to the very close of the assault. Whenever these muscles let entirely loose from their tonic contraction the attack for that time is quite at an end. When this tonic contraction is fairly set up, there is also noted a rather tense or *on-the-strain* sensation of the general nervous system. Soon after this the full outburst of the storm is established.

When we take into consideration the character of the nerve supply of the sphincters and of the levator ani we may at once understand that the neurotic element in this affection quite clearly predominates over that of the visceral or chylopoetic, and that the symptoms referable to these organs arise secondarily and as an outgrowth of neurotic disturbance. That continuous contraction of the sphincters is their normal state is almost too well known to even mention. If such were not the case all evacuations must needs be involuntary. Hence, what we mean by tonic contraction of the sphincters, internal and external, is their painful or more or less distressing grasp of the lower end of the rectum, which continues throughout the inception, rise, and decadence of attacks of sick headache.

The sphincters and levator ani are supplied by branches of the pudic nerve, which in turn comes from the sacral, and this latter from the spinal cord. Hence the spinal cord presides over and controls this outlet of the alimentary canal. These muscles are classed among the voluntary. Now, if this irritable state is present, as I have tried to point out, so as to produce such unpleasant contraction in the earliest part of attacks of sick headache, and so continues throughout, it seems to me to clearly indicate an irritable condition of the spinal nerve centers that give expression in this symptom, in advance of almost any others commonly noted as prodromal, and far in advance of the grosser manifestations. The only special importance in this symptom is its advanced warning of the coming enemy—sick headache—giving time for preparation to meet or prevent the attack; and also in that it points to the neurotic origin of the affection, and in that the spinal nerve centers are early affected as well, no doubt, as those of the medulla. In one case, often noted, this symptom is frequently present two or three days in advance of the attack of sick headache. At about the time this symptom is noted, the temperature may be found from 0·5° to 1·5° above normal. I have not yet made a sufficient number of thermometric tests on this point, however, to feel positively assured of its accuracy in many cases.

It is a common expression with persons who are migrainous subjects to say, in response to inquiry, "I am always costive at the time the headache is coming on," or, "I never have the headache when I am not constipated." Now, I do not believe that these sufferers are always really constipated at such times more than at others. But through the increased reflex action of the spinal nerves, due to abnormal irritability, these sphincters grasp the outlet of the rectum with unnatural tightness and retain the contents there, in this way, an unusually long time, during which the fecal lumps become dry, hard, and difficult of emission. This gives the appearance of constipation, when, in real fact, if a person thus affected would go to stool at his regular time he would most likely effect an evacuation, and so remove one etiological factor of migraine. The sphincters are voluntary muscles, and can, therefore, be relaxed at will. But during threatened sick headache it requires constant volitional efforts to keep them slack.

True, I have spent considerable time and ink on the prodromic symptoms of an attack of migraine. But this has seemed necessary. It is especially desirable to make these clear, for it is only in the early portion of such attacks that treatment is of greatest benefit to the sufferer.

The morbid manifestations of a fully developed assault are quite well known. With most persons there is well marked gastric disturbance. This may result from acute dyspepsia, acidity, a sense of weight or distention in the stomach, or distressing nausea, vomiting, etc. There is sharp pain in the head, generally in one temple, or it is supra-orbital or occipital. It may occupy the crown. Sometimes the whole head is involved. Often the whole man is sick. There is now a rise in temperature, greatly and painfully exalted sense of hearing, and well marked photophobia. A light brought into the room at once excites great suffering, even though the eyes be closed and the head covered. The character of the pain is not always alike. Sometimes it is of the grinding, boring, agonizing character, often aggravated at every pulsation. Again, it is that of clavus, or it is of the most sharp, lancinating fierceness conceivable. Sometimes there is a heavy dull pain accompanied with great distress from nausea or vomiting. During this stage there is great pallor of skin, or the exact reverse of it, according to whether there is determination of blood to the head or not; and there is every grade between these two extremes. Whenever there is an anæmic cerebrum, there, quite surely, will be found a dilated pupil, feeble pulse, and distressing prostration. In such a case the pain is nearly always of the keen, lancinating character, and generally considerable gastric distress without much nausea. In the red and turgescent-faced subject of migraine there is far more apt to be excessive nausea, some vomiting, and a terrible thumping headache, with contracted pupil, congested conjunctiva, hot, dry skin, and hard, full pulse.

One almost constant symptom in all forms of these attacks is coldness of feet and of hands. Another one of this stage is a heavy soreness and some tenderness of the trapezius and rhomboid muscles. To these, many minor and some graver uncomfortable symptoms might be named, but we forbear, as we yet have a little mercy on the reader. Some distinct types of this affection have not been named here at all.

Treatment.—How to say much in a few words here is difficult to determine. Preventive measures are by far the most effective in producing permanent good. Is the subject overworked in mind or body? Give him rest, if possible. If rest is not attainable, give him as complete rest as you can. A change of labor, or a change of places, of diet, of surroundings, modes of thought, or of associates, the leaving off of tea, coffee, *tobacco and spirituous drinks*, late hours, moderation in venery, moderation in eating, and a careful choice of the food taken, the regulation of exercise and a proper time for it, the avoidance of undue excitement, and of immoderate laziness while using a full diet; all these and many other points need looking after, and demand careful attention at the hands of the physician, in order that he may direct his patient, and help him to avoid bumping against some of these rocks greatly to his discomfort. The more nearly the migrainous patient approximates a true physiological plan of living, the more surely will he escape the assaults of his bitter enemy. But if he live in violation of the laws of health, he will have frequent occasion, like Ahab of old, to cry out, "Hast thou found me, oh! mine enemy," but unlike Ahab, will not be able to drive him away so effectually, as that he shall never return during this lifetime. Nay, more, the laws of heredity may bind this same enemy to the temples of the children. During the intervals of attacks, in addition to precautions above referred to, a little steady medication may be made quite effective. Dyspeptic trouble should be carefully removed. Also constipation, and any morbid habit of system, when possible. Then, perhaps, no one remedy will yield as much benefit alone, as a long continued use of nux vomica. A pill of ext. nucis vom., gr. ss., twice or thrice a day for weeks together. Some will not bear so much. To this may be added, a part of the time, gr. $\frac{1}{16}$ to gr. $\frac{1}{8}$ of arsenious acid. If constipation is prominent, add also to the pill aqueous ext. aloes, gr. ss., and fel. bovinum, gr. ij. to v. The addition of ext. belladonna is often beneficial. When all these are combined, it is better to divide the dose into two pills. Sometimes a minute dose of arsenic alone, three times a day, will do much to effect relief in the frequency of attacks. The steady, careful use of galvanism will often prove highly useful. Sometimes iron is needed. Sometimes a bad habit needs only to be corrected. Sometimes the removal of constipation alone will do the whole work of giving relief. Each case must be met and treated as found. With saying this much as to general treatment, we shall turn now to that needed during an assault of this misery-making affection.

Here we are met at the very threshold with the clinical fact that no two cases are alike, and seldom do we see two cases that will alike yield to the same plan of treatment. Only a careful analysis of each case in hand will ever enable us to meet with ready success in securing relief during the time of attack.

If possible, the patient should be placed in a dark, quiet room, of moderate temperature, and after bathing the feet for half an hour in *hot* water, in which a handful of mustard has been thrown, he should lie quietly down and sleep, if he can. There is a little knack in using a foot-bath that it may not be needed to name. It will do no harm to do so, however. At first, place the feet in water as hot as the feet will bear, throw in the mustard, and every few minutes add a little *hot* water to the foot-bath. This will keep the temperature up, and soon the feet will comfortably bear water very much hotter than at first, and more benefit will accrue to the bather.

If there is great nausea an emetic of fl. ext. ipecac or zinci sulph. will be very advantageous. A large drink of hot water, a pint, two pints, or even more, taken with or soon after the emetic, will be very beneficial in emptying and washing out the perhaps loaded stomach, or one that may contain bile. If there is acidity give soda carb., ʒ j to ʒ ij., and repeat in a short time, if needed. A saline aperient may be often best. These measures, promptly carried out, often yield quick relief. If not, then the system is ready for some form of anodyne, or nervous stimulant, or nervous sedative. It is not always that such measures as above named can be carried out, as the business or situation of the patient will not permit it to be done. But whether these or similar means have been adopted or not, the question of immediate relief is one that demands our attention. The sufferings are often so acute that the patient will brook no long delay for relief. What now shall be done? Well, we must take a moment to survey our patient. Has he a dilated pupil, pale skin, cold hands and feet, feeble pulse, great prostration, pain confined to temples or supra-orbital region? If so, and he has a sour stomach, give at once soda bicarb., ʒ ij. in half a glass of water. That puts one obstacle out of the way promptly. Now to such a patient I have many times given very prompt relief by such a formula as this—

℞. Ext. aconiti rad., fl. .... gtt. iv.
Ext. belladonnæ, fl. .... gtt. iij–v.
Morphiæ sulph. .... gr. $\frac{1}{16}$
Spts. æth. nit .... ʒ ss.
Aquæ vel syrupi .... q. s. M.

SIG.—Take this quantity every ten to twenty minutes until relief is afforded, or until the characteristic effects of the aconite or belladonna become apparent to a marked degree.

Alleviation most always comes before the physiological effects are made very manifest. The different remedies in this prescription may be varied to suit each case. I have one patron to whom I give this formula, in this wise—

R. Ext. aconiti rad., fl. .... gtt. xv.
Ext. belladonnæ, fl .... gtt. x.
Morphiæ .... gr. $\frac{1}{4}$.
Spts. ammon. arom .... gtt. xx.
Or, in lieu of the latter,
Spts rectificatis .... ʒ j.
Aquæ vel syrupi .... q. s. M.
SIG.—Take at once.

This is repeated with a full or partial dose of aconite in three or four hours, if needed. But generally a single dose so far settles the matter as that he will go about his business without stopping, often becoming entirely free from suffering, or so sufficiently alleviated as not to especially care for the pain. But if I find this patient with a greatly disordered stomach, inactive kidneys or liver, or costive bowels, this dose will not afford thorough relief. It will dull the keen suffering, but there is no real comfort attained until the organs above referred to are brought to a full performance of their proper functions. This may be done by remedies and means named before. But I want especially to name a cathartic, not much in use, that is often happily adapted to many of these cases, and especially to the last conditions above mentioned. I refer to sulphate of soda:

R. Sodæ sulphat .... ℥ j.
Sacchar. alb .... ℥ ij–iv.
Acid sulph. arom .... gtt. xx.
Aquæ .... q. s. ℥ viij. M.

SIG.—Stir well and drink at once, or within a short space of time.

This acts as a pleasant and very prompt cathartic, and for many reasons, which I cannot now name, it produces a sensibly good effect at once. Lemon juice may be substituted for the arom. sulph. acid, and it will be better given in hot water. It does better work when received by an empty stomach. If possible, it should not be given soon after a full meal. It must be remembered, however, that the large dose of aconite named in the case above mentioned is not a safe one to give in every case. Many persons would be absolutely poisoned by that quantity given at a single portion.

In very many cases, suiting the description given above, and treated by the plan named, it will be found that a strong cup of hot coffee and a little quiet rest will settle the whole trouble. Also, that sometimes such a patient may have a very keen appetite, which, if moderately indulged, may bring prompt relief. But if the patient be of intemperate habit in the use of coffee or tea, these agents will only add to his sufferings. If his stomach is already encumbered with food, or the tongue shows a heavy yellow coat, or is thick and indented by the teeth, having a white fur all over its surface, it will be unsafe to advise him to eat, however keen his appetite may be. It will but add to his pain, or prolong the attack.

Again, where the attack has been brought on by overwork, and there is marked exhaustion, a full dose of nux vomica alone may and sometimes does afford wonderfully prompt relief. The same is sometimes effected by a dose of ammonia, or of whisky. But the use of the latter is of questionable propriety, even in the most temperate, as it may lead to its habitual and therefore dangerous employment.

But we have yet another class of cases of this same affection, but presenting symptoms exactly the reverse of those we have had under consideration, if we may, of course, except the pain. They are full blooded, red faced, and perhaps fleshy people. In them the head will be hot, face flushed, even turgid, the pulse hard and full, and every systole of the heart will cause a thumping pain to be felt in the head. These cases need the hot foot-bath, perfect quiet, often an emetic given in an *abundance of hot water*, so as to secure easy emesis and free perspiration. If the stomach will receive it, large doses of bromide of potassium will serve a very good purpose. Ergot with it may add to its power. But I prefer the free use of aconite to the ergot here; and it may be given in quite liberal doses. It will soften the systole of the heart better than ergot, and have anodyne advantages far superior to it. The free use of a saline cathartic in such a case will be beneficial, and we generally prefer the one above named.

In these cases of full habit with a tendency to congestion, the use of arsenic in the interval will produce a very wholesome effect. This will be found especially so where the subject has passed middle life and atheroma has begun, and if there is a sluggish venous circulation, and puffy condition of the face or eyelids, its use is strongly indicated, and should be continued for a long period. If the bromide of potassium be used in the congestive form of sick headache, it should be given in large doses frequently repeated.

It will be noted that I have set forth the two extreme conditions under which sick headache is found to exist. One will not see many cases until he will note every grade between these extremes. To meet each case successfully will require very close discrimination and a clear understanding of the nature of this affection and of its therapy. One reason why migraine is a professional opprobrium, is because of the very little attention given to its pathology and to the proper interpretation of individual symptoms. We will make a few suggestions that will, we think, help

to determine the proper course to be pursued in these cases, and then close.

It will rarely be wise to advise strong coffee in sick headache when the patient is an intemperate user of coffee or tea.

It will rarely do well to advise any form of opiate in the congestive form of headache. If the pupil is contracted or contracts quickly under a moderate light, the use of an opiate will be of questionable propriety.

In the congestive sick headache, large doses of potass. bromid. are clearly indicated. In those cases where the congestion is not well marked, but where the pupil is but little dilated or contracts quickly under moderate light, potass bromid. is indicated in tolerably large doses, *i. e.*, ʒss. repeated every half hour until relief is afforded. Aconite may well be added. In all these forms of headache aconite may be used with distinct advantage with the bromide. Sometimes without it.

It will always be wise to correct acidity of the stomach, to open the bowels if costive, or if not already quite free, to stimulate the liver, kidneys, and skin. A hot mustard footbath is of great utility in most all forms of sick headache. A tolerably dark, cool, quiet room will be the best resort for these patients during the assault. All business and worry of every kind should be put aside for the time. The patient should, under any form of sick headache, abstain from any but very light, digestible food in very moderate quantities. The exception to this is only found in the real—not apparent—hungry headache, as it is commonly called.

An emetic, a mild one, may be given with marked benefit where there is great nausea, or where there is a load of undigested food in the stomach. In cases presenting the dilated pupil, pallid face, cold extremities, weak pulse, small and frequently repeated doses of morphiæ sulph., with aconite and belladonna, will be found very useful. If the prostration is very marked, arom. spts. ammonia may be also given. Sometimes a pretty full dose of ext. nucis vom. will act like a charm.

Some of these latter cases will tell you never to give them morphia during sick headache, as it always leads to excessive vomiting and a great aggravation of the distress. But if to such a case—the indications being for it—you give morphiæ sulph., gr. $\frac{1}{40}$, or even $\frac{1}{60}$, every five minutes, in a teaspoonful of water, until the pain subsides, your patient will bear it and be surprised at the thorough and prompt relief afforded. I have often tested this practice thoroughly, to my great satisfaction.—*Med. and Surg. Reporter.*

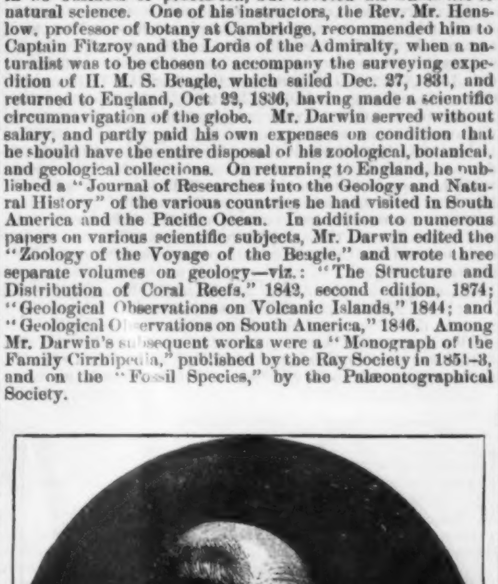
CHARLES ROBERT DARWIN.*

The death, on Wednesday, April 19, 1882, of Mr. Charles Robert Darwin, the eminent naturalist and philosophical inquirer of world-wide renown, has called forth in England and in every civilized country unanimous and unqualified testimonies to his great merits as the leading scientific mind of his time. During forty years past, living in comparative retirement at his country residence, Downe House, near Farnborough, Kent, Mr. Darwin has steadfastly pursued his experimental researches, and has from time to time published their results, with those of his profound and comprehensive speculations, till he has gradually won the assent of all well-informed persons to a few grand principles concerning the development of specific forms of organic life. His theory of the origin of species, vegetable and animal, referred them to the operation of a general law of nature, in the universal struggle of living organisms for subsistence, and in the competition for opportunities of reproducing their kind, tending to the survival of the fittest types, and to the modification of their progeny in the course of successive generations, by more and more distinctive peculiarities growing up in those organs or features which aided most effectually in the preservation of the race. Individual types of exceptional vigor, and with particular adaptation to surrounding circumstances, would thus become the progenitors of distinct species. Mr. Darwin went so far in his famous book, which appeared in November, 1859, formally announcing this view of natural history, as to say: "I cannot doubt that the theory of descent, with modification, embraces all the members of the same class. I believe that animals have descended from at most only four or five progenitors, and plants from an equal or lesser number." He looked forward even to a higher generalization. "Analogy would lead me one step farther," he said; "namely, to the belief that all animals and plants have descended from some one prototype; but this inference is chiefly grounded on analogy, and it is immaterial whether or not it be accepted. The case is different with the members of each great class, as the Vertebrata, the Articulata, etc., for here we have distinct evidence that all have descended from a single parent." We may quote also the impressive words with which Darwin concluded his treatise: "From the war of nature, from famine and death, the most exalted object which we are capable of conceiving—namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that while this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning, endless forms, most beautiful and most wonderful, have been and are being evolved."

In the "Origin of Species," above quoted, Mr. Darwin had not actually expressed his views as to the ancestry of man, though he had left them to be very clearly inferred. "It seemed to me sufficient to indicate that by this work 'light would be thrown on the origin of man and his history,'" for this implied that man "must be included with other organic beings in any general conclusion respecting his manner of appearance on this earth." But in the "Descent of Man, and Selection in Relation to Sex," which was published in 1871, Mr. Darwin expressly dealt with this most interesting question. He presented man as co-descendant with the catarrhine or "down-nostriled" monkeys, from a hairy quadruped, furnished with a tail and pointed ears, and probably a climber of trees. Nay, he traced back the chain of descent until he found as the progenitor of all the vertebrate animals some aquatic creature, hermaphrodite, provided with gills, and with brain, heart, and other organs imperfectly developed. The treatise concludes by remarking what are the hopes which the advance of the human race in past ages seems fairly to justify; he says we are not, however, concerned "with hopes or fears, but only with the truth as far as our reason allows us to discover it. I have given the evidence to the best of my ability; and we must acknowledge, as it seems to me, that man, with all his noble qualities, with sympathy which feels for the most debased, with benevolence which extends not only to other men, but to the humblest living creature, with his god-like intellect which has penetrated into the movements and constitution of the solar system—with all these exalted powers—man still bears in his bodily frame the indelible stamp of his lowly origin."

After the publication of his first great work, Darwin continued to gather evidence tending to strengthen his theory. In 1862 he published his remarkable work on "Fertilization of Orchids;" and in 1867 his "Domesticated Animals and Cultivated Plants; or, the Principles of Variation, Inheritance, Reversion, Crossing, Interbreeding, and Selection under Domestication." In 1872 Mr. Darwin published "The Expression of the Emotions in Man and Animals;" in 1875, "Insectivorous Plants;" in 1876, "Cross and Self Fertilization in the Vegetable Kingdom;" and in 1877, "Different Forms of Flowers in Plants of the same Species." Only last year appeared his work upon Earth Worms, in which he traced the operations of worms in gradually covering the surface of the globe with a layer of mould.

Mr. Darwin was son of Mr. Robert Darwin, a country physician, and grandson of Dr. Erasmus Darwin, a man of considerable literary and scientific attainments, author of "The Botanic Garden," and other poems, and of "Zoonomia," and other ingenious speculative philosophical works. The mother of Mr. Charles Darwin was a daughter of Josiah Wedgwood, the eminent art manufacturer of Staffordshire. The late Mr. Darwin was born at Shrewsbury, on Feb. 12, 1809, and was educated at Shrewsbury Grammar School, at the University of Edinburgh, and at Christ's College, Cambridge. Having inherited a good private fortune, he engaged in no business or profession, but devoted his whole life to natural science. One of his instructors, the Rev. Mr. Henslow, professor of botany at Cambridge, recommended him to Captain Fitzroy and the Lords of the Admiralty, when a naturalist was to be chosen to accompany the surveying expedition of H. M. S. Beagle, which sailed Dec. 27, 1831, and returned to England, Oct 22, 1836, having made a scientific circumnavigation of the globe. Mr. Darwin served without salary, and partly paid his own expenses on condition that he should have the entire disposal of his zoological, botanical, and geological collections. On returning to England, he published a "Journal of Researches into the Geology and Natural History" of the various countries he had visited in South America and the Pacific Ocean. In addition to numerous papers on various scientific subjects, Mr. Darwin edited the "Zoology of the Voyage of the Beagle," and wrote three separate volumes on geology—viz.: "The Structure and Distribution of Coral Reefs," 1842, second edition, 1874; "Geological Observations on Volcanic Islands," 1844; and "Geological Observations on South America," 1846. Among Mr. Darwin's subsequent works were a "Monograph of the Family Cirrhipedia," published by the Ray Society in 1851-3, and on the "Fossil Species," by the Palæontographical Society.



THE LATE MR. C. R. DARWIN, F.R.S., LL.D.

On Sunday last, both in Westminster Abbey and in St. Paul's Cathedral, the preachers spoke of Mr. Darwin's life and labors, praising him for his "pure and earnest love of truth," and his patient care and industry in its pursuit. He was, said Canon Prothero, "the greatest man of science of his day, but was so entirely a stranger to intellectual pride and arrogance that he stated with the utmost modesty opinions of the truth of which he was himself convinced, but which, he was aware, could not be universally agreeable or acceptable. Surely in such a man lived that charity which is the very essence of the true spirit of Christ." In like manner, Canon Barry, who preached at Westminster in the evening, referred to Mr. Darwin as a leader of scientific thought, observing that "the fruitful doctrine of evolution with which the late professor's name would always be associated, lent itself at least as readily to the old promise of God as to more modern but less complete explanations of the universe. The principle of selection was by no means alien to the Christian religion, but it was selection exercised under the Divine intelligence and determined by the spiritual fitness of each man for life hereafter. And to man was accorded the privilege of free will, which enabled him to be a fellow worker with God in the great scheme of Providence. In the natural life of the brute creation the struggle for existence was the constant and dominant motive; but the spiritual life of mankind was refreshed and intensified by obedience to the contrary doctrine of self sacrifice, which lay at the root of all the teaching of the Gospel."

Canon Liddon, in his sermon at St. Paul's, observed "that when Professor Darwin's books on the 'Origin of Species' and on the 'Descent of Man' first appeared, they were largely regarded by religious men as containing a theory necessarily hostile to religion. A closer study had greatly modified any such impression." It is seen that, whether the creative activity of God is manifested through catastrophes, as the phrase goes, or in progressive evolution, it is still His creative activity, and the really great questions beyond remain untouched. The evolutionary process, supposing it to exist, must have had a beginning; who began it? It must have had material to work with; who furnished it? It is itself a law or system of laws; who enacted them? Even supposing that the theory represents absolute truth, and is not merely a provisional way of looking at things incidental to the present stage of knowledge, these great questions are just as little to be decided by physical science now as they were when Moses wrote the Pentateuch; but there are apparently three important gaps in the evolutionary sequence which it is well to bear in mind. There is the great gap between the highest animal instinct and the reflective, self-measuring, self-analyzing thought of man. There is the greater gap between life and the most organized matter. There is the greatest gap of all between matter and nothing. At these three points, as far as we can see, the creative will must have intervened otherwise than by way of evolution out of existing materials—to create mind, to create life, to create matter. But, beyond all question, it is our business to respect in science, as in other things, every clearly ascertained report of the senses; for every such report represents a fact, and a fact is sacred as having its place in the temple of Universal Truth."

Mr. Darwin married, in 1831, his cousin, Miss Emma Wedgwood, and he leaves behind him, besides his widow, five sons and two daughters.

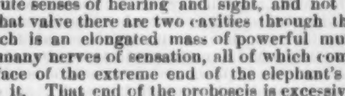
The funeral of Mr. Darwin took place in Westminster Abbey on Wednesday, April 26. He is buried next to the grave of Sir Isaac Newton, with whom and with Dalton, the discoverer of the atomic theory of physics, Darwin has been ranked by some recent commentators upon the progress of the natural sciences.—*Illustrated London News.*

AN ELEPHANT'S HEAD.

It is a common delusion that an elephant smells through its trunk, but the fact is, nevertheless, that an elephant's proboscis is not more legitimately to be considered as its nose than a snipe's bill is to be looked upon as its organ of smell. So says Mr. H. H. Cross, of the Barnum, Bailey & Hutchinson Show, an authority on the subject of elephants. During more than nine years he was constantly traveling, as an artist correspondent of the London *News*, in Africa, Asia, and Ceylon, where he had every possible facility for studying those animals, both wild and tame. And, as elephants possessed a sort of fascination for him, he did not neglect his opportunities. He carefully studied their habits, and when he had shot one of them he studiously dissected it and made accurate drawings of the various parts. This work he prolonged until he possesses a fund of information.

The question having been propounded to Mr. Cross, "Has the elephant a nose? and if so, where does it begin, and where does it end?" he obligingly delivered a lecture on the elephant's head, illustrating it as he went along with sketches. "The elephant has one nostril," he said, "or what may properly be so considered, which extends downward from the air passages of the head, and has its opening in the roof of the mouth, very near to the front. Interiorly it communicates with the front or lower part of the single cavity which exists in the base of the elephant's proboscis. There is a valve in the trunk just below that opening, which prevents anything from that interior passing down into the trunk, and so being mixed with the animal's food and drink. That valve is under the control of the beast, opens when he breathes, and closes when he fills his trunk with water in drinking, so as to prevent the ascent of the water, which would otherwise go direct to his lungs. His olfactory nerves are in that nostril, and anything that he wants to smell carefully he brings up with his trunk to the opening in the roof of his mouth. It is an open question, and subject to considerable doubt, whether he can smell anything, except perhaps an exceedingly strong odor by an inhalation through the trunk. Travelers have imagined that wild elephants scented their approach at great distances, but it is most probable that the animal's warning came through their acute senses of hearing and sight, and not by scent. Below that valve there are two cavities through the proboscis, which is an elongated mass of powerful muscle, containing many nerves of sensation, all of which come near to the surface of the extreme end of the elephant's trunk, or close to it. That end of the proboscis is excessively sensitive, and even a slight blow on it will cause acute pain to the animal. It is generally imagined that when the elephant strikes a person, he strikes downward and with the end of his trunk, but nothing is more erroneous. He is too tender of himself to hurt that delicate bunch of nerve points by dealing a blow with it, however light. When he strikes he doubles back the end and deals an upward or sidewise blow with the bent portion of it, the muscle of which he hardens up until it is almost like iron.

"In two respects, beyond that interior nostril, the mouth of the elephant is peculiar. In the first place, he does not chew his food with a sidewise grinding motion, but with a forward and backward chiseling sort of motion. He has twelve large flat teeth, six on each side—three above and three below. The teeth in the upper jaw when at rest are advanced one tooth ahead of those in the lower jaw, and when the latter is in full swing it goes far enough forward for one of the lower teeth to pass beyond the foremost one of the upper set. Thus:



Quiescent. *Chewing.*

"There is no necessity for poking one's fingers between the teeth to get an idea of the force stored up in that part of the brute. The muscles of the mouth at the sides are strong enough to hold the hand of the most powerful man so that he cannot pull it away, and the elephant frequently shows what his teeth are capable of by crunching to dust hard pebbles as big as hen's eggs, seemingly just to amuse himself. The lower jaw does not open wide enough to admit of the separation of the teeth, which are well back, more than three inches. The second queer thing about the elephant's mouth is his tongue. It is often expressively said of a scold 'that her tongue is hung in the middle, and works at both ends.' The elephant's is exactly the opposite, for it is hung at both ends, and works in the middle. It is a powerful muscle, which the animal can flatten or swell up big and hard at any point, and move the swelling along it either way just as he pleases. You can get the best idea of it by supposing a rubber tube fast at both ends, with a big ball inside, distending it and moving by its own volition, backward and forward. You can pass your hand clear through under the middle of an elephant's tongue, but it is always safest to perform that experiment after the elephant is dead. The opening into the œsophagus is about four inches above the level of the teeth, and it is the business of that tongue to shove things up there for swallowing by humping itself and pushing.

"On each side of the elephant's head, in the temple, between the eye and ear, you can observe a little hole. That hole is the external issue of a very small channel, which goes through about four inches of flesh, upward nearly as much more, and then penetrates the bone of the skull—which is

quite thin at this point—into the brain cavity. Out of this flows a sort of sirupy, leaden colored discharge, most abundant when the animals are excited or overheated. I cannot say that I have any definite knowledge of why those holes, or issues, as we commonly term them, have been put there and I'm not certain that an elephant couldn't be built and run successfully without them. But I do know that the elephant himself seems to be used to having them, and takes considerable interest in keeping them open. It has been affirmed that the hardening of the discharges in those channels, closing them up, was the cause of elephants going mad; but I doubt that, for I don't think the elephant ever allows them to get stopped up. I have often seen an elephant hunt for a slender stick, or branch, or splinter, and, after holding it up and examining it critically with one of his keen little eyes, if he found it not sharp enough for his purpose, deliberately grind down its point by rubbing it upon a stone, and, when its shape suited him, use it to pick out and open those issues, working it just as delicately and deftly as a man would handle a match or the round end of one of his wife's hairpins to poke in his ears. So the elephant, no doubt, knows what those issues are for, and has his own good reasons for taking care of them. There is still another issue in the trunk, the purpose of which is yet more mysterious to me. Sometimes its opening is in one of the cavities, and occasionally, as in the case of Maudrie, one of the Barnum elephants, it is external, always back about two feet from the extreme end of the trunk. At its opening it is at large as the ones behind the eyes, big enough to easily admit a large rye straw, but instead of connecting anywhere it runs off into a multitude of very small ramifications and channels, finer than a cambric needle, among the mass of muscle three or four feet above in the trunk. By injecting this issue with vermilion, after death and before the animal got cold, I have been enabled to trace it in the way I speak of, but have never learned anything more about it. Perhaps it is intended as a conduit to carry off the waste from that huge mass of muscle. Just about the issues in the temples and in the cavities of the eyes the bone of the skull is thinnest, and those are the vulnerable points at which the experienced hunter always aims. In some other places, on the forehead for instance, it is fully an inch in thickness, and on those thin spots behind the eyes it is protected by a cushion several inches thick, of very solid flesh, so that not even a powerful blow there would be likely to have any effect on the bone beneath. It saves them from being killed by their furious butting when they fight.

"The brain of the elephant is remarkably small in proportion to the size of the animal. I have never known of an elephant having a greater weight of brain than fifty-two ounces, and that amount has often been largely exceeded by men. Do you notice those broad callosities over the prominent cheek bones of the beast? When he lies down to rest, whether on dry land or in the water, he puts the side of his head on the ground, and those great callous lumps are his pillows. I mention his sleeping in the water because that is his favorite resting place. Wild elephants feed during the day on high ground, but at nightfall descend into marshy localities, and if they can find a suitable place, will lie down in the edge of a stream or pond, to sleep covered entirely by the water, except the ends of their trunks, which they leave lying up on the bank to breathe through. If the very sensitive tips of their trunks are much annoyed by mosquitoes or other insects, they will roll them in the mud, to put on a protecting shield for the night. There is no question in my mind that the elephant is a sort of amphibious hog, just as properly to be so classified as the hippopotamus or tapir. He can stay entirely under water much longer than some other animals that are commonly known as amphibious. I have often seen an elephant remain wholly submerged for five minutes at a time. Just one thing more about the elephant's head. He has a double supply of eyelids—an outer pair that close and open up and down like other animals' eyelids, and interior ones, red and semi-opaque, that move forward and backward. The object of those underneath seems to be to clean the eye of any foreign substances that may accidentally get into it by pushing them out to the corners and there expelling them."—*N. Y. Sun.*

A NEW DEPREDATOR INFESTING WHEAT-STALKS.

UNDER the title of *Isosoma allynii*, Prof. G. H. French, of Carbondale, Ill., describes what he believes to be a new wheat pest, in the *Prairie Farmer*, for December 31, 1881. He has been kind enough to send us types of this new species, which, as we suspected from the description, prove to be not Isosoma, but a species of Eupelmus, parasitic, doubtless, on some of the wheat-stalk feeders and probably on some species of Chlorops. A detailed description, published in the *Canadian Entomol gist* (January, 1882), of this "*Isosoma allynii*," shows also that Prof. French drew it from the Eupelmus. The error would have less significance but for the existence of a true Isosoma affecting wheat much in the manner related by him, and undescribed.

We have been studying this last insect for nearly two years past from specimens received from Tennessee and

FIG. 1.—Larva of *Isosoma tritici* Riley. *a*, ventral view; *b*, side view; *c*, antenna; *d*, mandible; *e*, anal joint beneath.

Missouri. The larvæ were first received in June, 1880, passed the winter in the pupa state, and issued as adults in March and April, 1881. Specimens received the present season have issued in December, induced doubtless by the long-protracted warm weather which generally prevailed in those sections. Although congeneric with the joint-worm (*Isosoma hordei*) of Harris and Fitch, it differs widely from the latter in habits and appearance. The joint-worm forms a gall-like swelling at a joint near the base of the stalk, while the species under consideration feeds on the interior of the stalk between the joints higher up without causing a swelling. The adult insect is more slender and much more hirsute than is the joint-worm fly, and is perfectly smooth upon the dorsum of the thorax, while the latter presents a marked punctation; moreover, the customary pronotal spot in the new species is large and yellow, while in *hordei* it is almost indistinguishable. We have recently characterized the insect in the *Rural New Yorker*, and append the following description:

"ISOSOMA TRITICI, n. sp. *Female*.—Length of body, 2·8 mm.; expanse of wings, 4 mm.; greatest width of front wing, 0·7 mm.; antennæ sub-clavate, three-fourths the length of thorax; whole body (with the exception of metanotum, which is finely punctulate) highly polished, smooth, and sparsely covered with long hairs most dense toward end of abdomen; color, pitchy-black, without metallic luster, the scape of antennæ, occasionally a small patch on the cheek; mesoscutum, femoro-tibial articulations and tarsi (except last joint), tawny; pronotal spot large, oval, and pale yellowish in color; wing veins, dusky-yellow, and extending to beyond middle of wing; submarginal three times as long as the marginal, postmarginal very slightly shorter than marginal, and stigmal also shorter than marginal."

Described from 24 ♀ specimens; ♂ unknown. Of these 24 specimens, only one was fully winged, two were furnished with hind wings only, while the rest were wingless.

It is worthy of remark that the species seems to be quite closely related to the European *Isosoma linearis*. This species was bred from wheat by Dr. Giraud, who considered it inquilinous in the swellings formed by the Dipterous *Octhiphila polystigma* of Meigen. Kaltenbach remarks, however, that although obtaining the Isosoma many times from the wheat, he never succeeded in seeing the Dipteron—a very suggestive fact.

Walker (Notes on Chalcididæ, p. 7) states, in reference to the "humeral spot," that although present in all European species of Isosoma, it is absent in American and Australian representatives of the genus. In *tritici*, however, it is a prominent feature of the markings, and even in *hordei* it is as evident as upon the European *I. verticellata*, which we have from Walker himself.—*C. V. Riley, in American Naturalist.*

THE LADDER-BACK ADDER.

THIS snake, which receives its popular name from the peculiar markings on its back, resembling a ladder in appearance, inhabits Italy, Sicily, the Iberian peninsula, and the

THE LADDER-BACK ADDER.

middle of France. In disposition it is very pugnacious. It bites with ferocity and always bravely faces the enemy. In Spain it sometimes attains a length of nearly seven feet, and is always a dreadful foe of young hares and rabbits, which it pursues with great activity. In the middle of France it feeds on young birds and small mammals, climbing trees in pursuit of the former with great facility. It seems to delight in dry places, where it is frequently seen coiled up among the branches of shrubs.

The coloration of this snake is very characteristic; on a ground of a reddish yellow color there extend along the back and tail two black bands, which are connected at intervals by transverse lines, so as to give, as above stated, the appearance of a ladder. The sides are marked with black blotches forming small oblique bars which alternate with the transverse bands of the back. The belly, which is of a pale gray, is marked throughout nearly its whole extent with blackish gray blotches. In its young state the coloration of the reptile is different. The ground then, instead of being reddish yellow, is of a clear gray, the transverse black bands alone existing and the longitudinal ones not appearing till later. The oblique lines on the sides, however, are very pronounced, as are the blotches on the belly, where the black is much in excess of the white. The head is distinct from the trunk, wide at its base, and conical in shape. The snout projects above the lower jaw and has some resemblance in form to that of the wild boar. The sides of the belly are angular; the scales are smooth and lozenge-shaped; and the tail is equal in length to a sixth or seventh of the entire body. The bite of this species of adder, like that of many others, proves harmless.

BLACKBERRIES IN DELAWARE.

A REPORT of the prospects of the blackberry crop in the neighborhood of Laurel, Delaware, the chief blackberry producing part of the State, gives assurance of a bountiful supply for the coming season. Ten-acre fields are common, and some growers have 30, 40, and as high as 60 acres devoted to blackberries. It is expected that from ten to twelve car loads of berries a day will be shipped from Laurel throughout the season, or something like 2,500,000 quarts in all.

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